THE SETTLEMENT HIERARCHY
IN
SOUTH - EAST SCOTLAND

by

Leonard J. Evenden

Thesis Presented for the Degree

of

Doctor of Philosophy

of

The University of Edinburgh

in the

Faculty of Social Sciences

August, 1969

ACKNOWLEDGMENTS

The Author wishes to acknowledge the co-operation and encouragement of the numerous individuals and organizations contributing to the preparation of this thesis.

The Directors of this research, Professor J.W. Watson and Dr. R. Jones, never failed to express their interest in the project and to offer encouragement; in addition, Dr. Jones read and commented perceptively and constructively upon the draft preparations.

The Department of Geography of the University of Edinburgh made this study possible by granting the author a Demonstratorship; further, it defrayed certain of the expenses of the field work. Eight undergraduates of the Department assisted in the interviewing. These were: Miss K. Gizinska, Miss K. Goodfellow, Miss A. McKinley, Miss S. Pett, Mr. A. Clyne, Mr. D. Hendry, Mr. W. Stevenson, and Mr. W. Taylor.

The Scottish Census Office permitted the use of the manuscript data for the Index of Place Names for the 1961 Census in advance of publication.

Numerous officials of the Counties of south-east Scotland provided information regarding their constituent communities; the author was never turned away without an attempt being made to grant his requests. Several private organizations were equally co-operative. Many names could be mentioned if space permitted, but two individuals who were particularly helpful were Miss Ramage, General Secretary for the Scottish Women's Rural Institute, and Mr. D. Sydserf, Transport Manager for the East Lothian Co-operative Society in Tranent.

Mr. A. Strachan of the University of Leeds provided data from his research on the commuting patterns around Edinburgh.

Several hundred individuals in the study area took time to respond by post to the various queries directed to them, and between 1,200 and 1,300 others were willing to take time to talk with the author or his interview assistants and to give, freely, information about activities which are essentially personal. For these fascinating glimpses into their lives, the author is very grateful.

Further acknowledgment is due to the Department of Geography of Simon Fraser University, Burnaby, British Columbia, for its services in support of this research; in particular, Mr. L. Skoda directed the final production of maps. Dr. M.C. Roberts assisted in determining the operation of the Shear Index of Diversity.

Finally, the author wishes to express his gratitude to his wife, Polly, who, as a Geographer trained in Scotland, offered many insights into what was, to the author, a new landscape; she has unfailingly encouraged and unflaggingly assisted throughout the course of this work.

TABLE OF CONTENTS

LIST OF MAPS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

PERSPECTIVES

(a) The Enquiry

A substantial body of literature has built up in recent years which relates to Central Place Theory. Several major efforts have been directed at enunciating comprehensive statements of the theory while many studies have aimed to apply and test the body of established theory. (1) Empirical studies in various parts of the world have indicated the necessity to modify the theory in order to accommodate the many variations in settlement processes which have been studied. (2) It would seem, however, that two major weaknesses appear to stem from the blanket assumptions of "economic man", engaged in a constant struggle to minimize physical effort, and of the uniformity among individual behaviour patterns. There has been some recent attempt to broaden the scope of theory to strengthen it where these weaknesses are apparent, and the present essay aims to contribute to this attempt. In order to clarify the position of this work, the main developments alluded to will be sketched with reference to examples from the literature.

Geographers generally agree that the work of Walter Christaller marks the formal commencement of studies in Central Place Theory. He was the first to attempt a comprehensive statement relating to the spatial patterns of, and interactions among, settlements as they concern principles for interaction. (3) The theoretical conclusions of his

study, empirically based in southern Germany, have formed the basis of most enquiries since then into the nature of central places. Therefore a brief review of them is appropriate here.

Accepting the assumption of a flat homogeneous area with equally distributed productivity, the essential points in Christaller's theoretical formulation are, first, that the cardinal function of a city is to provide services to surrounding "complementary" populations. (4) Both "town" and "settlement" are rejected as suitable terms to designate the concentration of human activity he wished to focus upon because, in both cases, the more usual appreciations of these words evoke larger pictures than he wishes to suggest. The term central place is coined to describe the restricted meaning he wishes to ascribe to the settlements he studies: that is, he views the agglomerated settlement from the functional point of view of what are the activities which service the surrounding population. From this it follows that goods, services, and professions may be described as central, and the quality of the term is intended to be more abstract and general than the simple spatial connotation. Thus the organizing framework of a centre-margin model is defined and such controversial matters as distinctions between "urban" and "rural" are avoided.

Second, the importance of a centre is to be measured by the extent to which it services its "complementary region". This is termed its centrality.

Third, places offering comparatively large ranges of goods and services are termed higher order central places. They are more widely spaced than lower order central places which mainly offer frequently needed goods and services. The areas serviced by lower order

central places nest spatially within those of higher order centres, as do the range of functions of lower order places.

Fourth, an ordered hierarchy of central places may be expected. It comprises discrete groups of centres, each group being characterized by distinctive sets of service functions.

Fifth, spatial hierarchical forms tend to follow three principles: market, transport, and administration. The first implies that central places will nest according to a factor of 3; the second, a factor of 4; and the third, a factor of 7. In practice, all principles are operative with variable emphasis in any region. In order that complementary regions should parcel up the total given area in the most efficient way, central places tend to distribute themselves in hexagonal arrangements, thus packing the available space by the most compact forms.

The maximum extent to which a good may be distributed from a central place before costs of transport or competition render it uneconomic is called the range of a good. Implicit in this concept are other economic factors such as scale advantages and what Christaller terms "price-willingness". (5) "Price-willingness" may be seen as antecedent and analogous to the concept of threshold, defined by Berry and Garrison as the minimum purchasing power required to permit the supply of a central good in and from a central place with "normal" profits to the distributor. (6)

Under the limiting assumptions of uniform distributions on a homogeneous plain, the hexagonal network of central places is verified by Lösch as the most efficient. But Lösch regards the market, transport, and administrative principles to be merely special cases. This point

may easily be agreed and Christaller only claims that there is a tendency for landscapes to develop according to the three principles he enunciates, without any landscape being the exclusive product of any one of them. (7)

In a restatement of central place theory in 1958, Berry and Garrison formulate the ideas in terms of a process whereby central places logically emerge in an orderly spatial and hierarchial pattern from the implications of the operation of the concepts of threshold and range. (8) The advantages of their reformulation arethat the assumption of the uniform distribution of purchasing power and the resultant hexagonal structure of marketing areas, postulated by Christaller, and later supported by Lösch, may be relaxed. The theory therefore becomes more general and applicable than before.

In his recent book, Geography of Market Centers and Retail Distribution, Berry summarizes the course of empirical investigation he has followed "to evaluate the properties of central place systems in a variety of locations, and to compare the properties in the various areas". (9) Using both historical data and field surveys, four areas are analyzed; they include the Chicago metropolitan area, and three other regions: south-western Iowa, and northern and western South Dakota. In general, central place theory is substantiated but certain observations are made as a result of its application to different areas. First, the spatial extent of "trade areas" is seen to vary inversely with population density and second, higher order central goods and services tend to locate in progressively lower order centres as population density decreases; further, with decrease in population density and increase in spacing between centres, the trade areas tend to be more discrete

spatially, and this tendency is classified as a progression between the outer margins of the trade area and the centre so that the level of discreteness diminishes towards the centre through stages of increasing interaction and interdependence of places. In Berry's terminology, the stages from the outer margins are "rangelands", "wheatlands", "cornlands", (representing areas of activities of increasing spatial intensity), dispersed city, suburban, and urban. Such a classification describes, on a large and aggregate scale, a centre-margin model. But the use of population density as a summary measure of variation among areas and the analysis of the activities of two broad classes of individuals only ("farmers" and "urban dwellers"), are points about which further clarification may well be needed.

At approximately the same time that the present investigation commenced (Autumn, 1963), a general concern for the adequacy of central place theory became evident. Empirical studies raised questions not answered by the existing body of theory. A brief discussion of two studies follows to illustrate this and to provide background for the position of the present investigation.

R. A. Murdie highlights culturally determined attitudes as important modifiers of ostensibly economically determined patterns of activity in the complementary regions surrounding central places in Waterloo and Wellington Counties in Ontario. (10) Patterns of travel behaviour for traditional goods are compared for the Old Order Mennonite agricultural communities and "modern" Canadian farmers in the same area. Few apparent differences of spatial orientations appear between the Mennonites and others when considerations related directly to farming operations are involved: the Mennonites farm their lands

efficiently and often with modern methods. When other matters are involved, however, such as those pertaining to "personal" or "household" affairs, the patterns differ markedly. Whereas "modern" Canadians normally travel to Kitchener, the major centre of the area, to purchase clothes, the Mennonites patronize smaller centres close at hand for yard goods in order to make their own clothes. Perhaps the main functional difference underlying this contrast is the restriction on travel imposed by the Mennonites upon themselves by the use of the horse and buggy. This spatial restriction is accompanied by a lack of demand from these communities for a wide variety of central goods and services from which to choose. Thus the form of the settlement hierarchy is modified by a retention of higher order services and outlets for higher order goods in central places of lower order than would be expected, given conditions of fast transport, the wider selection of services, and the increased opportunities for multiple-purpose trips in the higher order centres, particularly Kitchener. Conversely, the higher order centres probably have not developed as fully as they might if the surrounding population were to take advantage of the economies of scale and selection that these centres can offer. It is clear that the development of the hierarchy in this region is conditioned by interpretations of religious values of this community as they affect daily life. Further, it is to be noted that Murdie finds a distinction in the comparability of activity patterns between the different cultural groups studied, based on whether the activities related to "business" or "personal" life.

R. E. Pahl has called attention to the necessity to introduce sociological concepts to a greater degree into geographical investigations. (11) Recently, in referring to his 1965 monograph, Urbs in Rure,

Pahl stresses that because of the obvious differences between the two main sub-groups of people which he found in certain Hertfordshire parishes, "...a non-spatial conceptual model was forced upon me". (12) For Pahl, this experience means that the geographical explanation involving a spatial focus, usually constructed with reference to the city or metropolitan centre, is inappropriate. He also comments that "...to group the whole population together...(is)...a meaningless exercise", and thus calls for greater attention to the kinds of people and personal activity being considered and for the modification of the common centre-margin model of analysis. Much of his evidence for these opinions lies in the analysis of employment locations, family networks, personal mobility, and the use of various towns or London for shopping and entertainment. Although contact with London is an element of some importance in daily patterns among those he designates "middle class", it is nowhere near as important as might be expected. And among the "working class" contact with London is minimal. Although Pahl turns aside the opportunity to investigate it, he has exposed an interesting and necessary problem in spatial geographical analysis: that space is seen in different perspectives by different groups of people. As he points out, space is seen as an opportunity for those in his middle class on the north-west fringes of London whereas it is a constraint upon those of the working class, not only because of the lack of means to overcome it in transport but also, and not unimportantly, because of the apparent lack of desire. And in the word "desire" lies a number of behavioural determinants such as the common characteristics of lesser job mobility among the working class, the closer proximity of family, and ties to the land and the traditional community in the case of

agricultural workers. The analysis of spatial patterns of personal activity with reference to central places and with an acknowledged awareness of the distinction between classes of people, would appear to be an eminently suitable topic for geographical study and this is also the conclusion reached in the early stages of investigation for the present study.

The present enquiry commenced in the Autumn of 1963. The area selected for study comprises seven counties in south-east Scotland: East Lothian, West Lothian, Midlothian, Roxburghshire, Berwickshire, Peeblesshire, and Selkirkshire. Preliminary testing of field procedures was carried out in East Lothian where test interviewing suggested that the social and economic structure of the landward population is markedly different from that either specified or implied in any of the studies of this nature. (Preliminary interviewing was conducted in the Spring of 1964; Pahl's monograph was published in 1965.) Estate owners and managers, and farm owners and managers (probably the "local" equivalent of Pahl's "middle class"), frequently have little to do with nearby towns or villages. In some cases they belong to, and actively participate in, local church activity, but their associations locally are generally weak on an <u>activity</u> basis. They tend to consider Edinburgh to be their main shopping centre and the posed questions, "How often do you go to Edinburgh and for what reasons?", drew incredulous looks from several. The answer of one farmer near Dunbar sums up the attitude well, if more extremely than most.

> "Between my wife and me, we must be in and out of Edinburgh six or seven times a day at least. And I have no idea how often it would be on a family basis because the children are in and

> out too. We go for all sorts of reasons, too many to enumerate; but, by contrast, we rarely visit the burghs around here."

It should be pointed out that by no means did all interviewees in this kind of social and economic category (several Rolls Royces are owned by the family) respond in this manner. Nevertheless, such patterns of activity do not describe isolated cases and they stand in striking and general contrast to the more prescribed lives of the far more numerous farm workers and others of similar socio-economic status.

It is for the farm workers, forestry workers, miners, and others with modest incomes who live in landward areas that the bus services and the van retailing services appear to be geared. While it is true that the economic level of individuals and households in the countryside appears to have risen to the point where more and more people are able to own small automobiles or vans, it also appears that many of those who buy them comprise younger elements in the population, and further, many of these younger people are leaving the countryside for cities and/or for North America and Australia. The older groups who remain appear slow to lay out a large amount of money for a car and to incur not only the additional expense but also the series of problems in learning to drive. This, of course, is no problem for tractor drivers, but others did indicate informally that they would be afraid to drive in traffic with confidence and it was much easier to take the bus. It is impossible to say to what extent the dour assessment of a gadget which would threaten or obliterate a small savings account is a factor in decisions not to buy, but the number of cars in the countryside is increasing at a rate which is probably slower than

would be expected on the assumption of a straight linear relationship between rising income and the acquisition of personal mobility and status by motor car. (13) The implication for a study of the patterns of movement in and out of functional centres therefore is that trips by public conveyance remain important. Experience proved, too, that interviewing is not possible on Saturdays because that is when large numbers of people take their weekly trip to town for general shopping. Food, however, is still normally purchased several times a week, if not daily, and factors in the retention of this pattern appear to include the lack of cold storage for large quantities, the devotion to "fresh baked" bread and cakes for tea, and the social rewards of personal communication fostered by the habit of purchasing food frequently. This pattern is made possible by the practice of van retailing, especially as organized by the Co-operative Societies in the region.

The travelling vans or mobile shops appear to constitute a considerable portion of the daily traffic along many of the roads. (14) It was a daily experience, while carrying out the field investigations, to encounter vans servicing the cottages when the author arrived for an interview, or to have an interview suddenly interrupted by the arrival of a van. Such was the importance of this interruption that the interview commonly had to be postponed for ten to fifteen minutes while money was fetched, orders called to the driver, and, especially if a number of women were involved, a general animated, and almost ritualistic conversation was carried on about the price and choice of goods, the weather, and the news from elsewhere. "Elsewhere" often meant neighbouring communities and farms, and illustrates the more local nature of the interests of this group of people as compared with the farm owners

and managers. Further, the vans themselves originate in local towns and burghs and, in the case of the co-operatives and the occasional private retailer, branches which operate vans are often located in quite small communities. For example, the East Lothian Co-operative Society, Gullane Branch, is responsible for a large van trade in an area which could be easily reached from Tranent, the main base for vehicles. During the field work then, the constant daily identification with certain local functional centres and other points in a fairly circumscribed area was found to be a striking and constant element of life in the landward areas.

Social and economic differences between component groups of the landward population, differences which are often conventionally expressed in terms of income and educational levels, are seen here as expressed in differing assessments of, and relations to, locations with which identification is made during and for the daily and weekly rounds of activity. Preliminary field work revealed that to study patterns of activity carried on by people in lower socio-economic ranks would be consistent with the enquiry into the settlement hierarchy of the study area because their contacts with central places are largely confined to those lying within south-east Scotland; and to study, in similar detail, the activity of those of higher socio-economic levels implies either the necessity of greatly extending the study area or of conducting an entirely different sort of enquiry based upon their different socio-economic ranking. The latter approach was pursued by Pahl. But the present enquiry seeks to identify characteristics of the settlement hierarchy of the chosen study area; this focus, plus an awareness of the differences among activity patterns among persons of different social

strata, combines with the evident need to concentrate studies of hierarchies upon varied sub-groups within populations to suggest the restriction of this study to those patterns of activity carried on by people comprising lower socio-economic ranks. This restriction is felt to be reasonable because it identifies this study as one of the few in the central place tradition of enquiry to be concerned with the specification of such a social variable and as subsequent analysis shows, spatial activity patterns do not violate the boundaries of the chosen study area except for a limited number of contacts, thus allowing hierarchical relations among centres of the region to be described with confidence.

Difficulties remain, however, in implementing this decision. Because the clear identification of social groups in the area would be a considerable sociological problem, some shorthand method is necessary. The technique relied upon most is the traditional geographical one of interpretation of landscape morphology. Farm labourers (even now sometimes referred to as "farm servants") generally live in row cottages set aside from the dominant residence, much more imposing in its proportions, of the farmer or manager. Occasionally, commuters are encountered in cottages in the Lothians near Edinburgh, but many of these are members of "working class" households and their contacts are thus taken to be part of the contacts of the household. Also, in the Lothians and eastern Berwickshire, small-holders form important groups and, roughly to the south of the Tweed, one encounters an increasing number of farmers and tenants who operate the land with little help. These latter tend to resemble the farm labourer and forestry worker groups in relation to contact orientations for services. Where

commuters, farmers, and farm managers were encountered in dwellings thought to house farm workers, there was usually little difficulty in identifying them - they frequently made a point of indicating their different status. Their interview results were scanned for obvious divergences from local activity patterns and, if there were none or relatively few, the results were retained for analysis; if an interview was conducted with a farmer or manager as well as a worker on the same farm, the numbers of weekly food purchases were averaged.

As a result of the survey of selected research carried out by other scholars, and as a result of preliminary investigations for the present study, the position of this enquiry may now be clarified. Central place theory, which has been acknowledged as potentially very powerful in explaining the distribution of settlements, may be seen to need the benefits of widespread cross-cultural studies, to rely too heavily upon wholly economic assumptions, and to require the specification of the qualities of life among people as they relate to social and economic differences. (15) In the present enquiry, the people interviewed regarding their behaviour in relation to the functional structure of settlement are specified according to social status and, for lack of a better term, they are described by the common general term, "working class".[16] Further, the nature of contacts with centres is restricted to those which may be conceived as "personal" or "household"; this excludes activities which may be construed as exclusively serving business interests, including farming. Thus agricultural engineers, for example, who confine their efforts to servicing farm equipment, are excluded because they are basically a business service. Accordingly, in Chapter II, where the functional structure of centres is analyzed,

only those functions to which an individual of the general public has direct access are included.

Having indicated the limits of what data will be dealt with in this study, the broad aims may be described by a series of questions:

1. What is the functional character of centres in south-east Scotland?

2. Does a stepped hierarchy of central places emerge in the study region, given the conditions of the study of central functions?

3. What is the nature and extent of regional relations of these centres as expressed in their various spatial spheres of influence?

4. What is the nature of the relations of central places with Edinburgh?

5. What is the nature of regional variations in the hierarchy, and are there implications which call for modifications of accepted statements of central place theory?

6. What are the implications for future regional organization in south-east Scotland?

All these questions are approached at various points throughout the essay and, as appropriate, are broken down into smaller questions for analysis.

FOOTNOTES Chapter 1 (a)

1. A comprehensive bibliography of relevant studies has been compiled by Brian J. L. Berry and Allan Pred. It contains a summary of the principal elements of central place theory. Central Place Studies: A Bibliography of Theory and Applications, Regional Science Research Institute, Bibliography Series, Number One, with Supplement. Supplement by H. G. Barnum, R. Kasperson, and S. Kiuchi, 1965.

2. See, for example, Pitts, Forrest R. (ed), Urban Systems and Economic Development, Papers and Proceedings of a Conference on Urban Systems Research in Underdeveloped and Advanced Economies, School of Business Administration, University of Oregon, Eugene, Oregon, 1962, 126 pp + x. Studies reported here were carried out in India, Ashanti, Japan, Korea, and the United States.

3. Christaller, W. Die Zentralen Orte in Süddeutschland, Jena, 1933. Trans. by C. W. Baskin, Central Places in Southern Germany, 1966, Prentice-Hall, Englewood Cliffs, New Jersey, 233 pp.

4. The order of the essential characteristics of central place theory closely parallels that by Berry and Pred, op. cit.

5. Christaller's terms are taken as translated by Baskin.

6. Berry, B. J. L., and W. Garrison, "A Note on Central Place Theory and the Range of a Good", Econ. Geog., XXXIV, 1958, pp. 304-311.

7. Lösch, A., The Economics of Location, Science Editions, John Wiley and Sons Inc., New York, 1967, 520 pp. + xxviii. Trans. from the German by W. H. Woglom and W. F. Stolper for the Yale University Press, 1954. See Chapters 9, 10, and 11 for the development of Lösch's arguments from which he concludes that the hexagon is the optimal shape for market areas.

8. Berry, B. J. L., and W. Garrison, "Recent Developments of Central Place Theory", Papers and Proceedings, Reg. Sci. Assoc., IV, 1958, pp. 107-120.

9. Berry, B. J. L., Geography of Market Centers and Retail Distribution, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1967. See pp. 3-58 The points mentioned here were elaborated earlier in Berry, B. J. L., and H. M. Mayer, Comparative Studies of Central Place Systems, Final Report, Office of Naval Research, 2121-18, Project NR 389-126, 1962.

10. Murdie, R. A., "Cultural Differences in Consumer Travel", Econ. Geog. XLI, 1965, pp. 211-233.

11. Pahl, R. E., "Sociological Models in Geography", Chapter 7 in Chorley, R. J., and P. Haggett, Socio-economic Models in Geography, University Paperbacks, Methuen, London, 1967.

12. Pahl, ibid., pp. 239. See also Urbs in Rure, London School of Economics Geographical Paper No. 2, 1965.

13. Rural Transport Surveys, Report of Preliminary Results, Ministry of Transport, London, HMSO, 1963. This report documents the results of a sample survey in the counties of Devon, Montgomery-shire, Lincolnshire, Westmorland, Kirkcudbrightshire, and Banff-shire. While not part of the present study area, if Kirkcudbright-shire, in south-west Scotland, may be assumed to resemble the eastern and central Borders, then the results may contain useful inferences for the present study. Kirkcudbrightshire has the highest percentage of all journeys taken by bus (25 compared with 12 for Westmorland, the second highest) (Table 4 in Report). Further, of all journeys examined by purpose, Kirkcudbrightshire has the highest percentage involving the journey to work (29 compared with 22 for Devon, the next highest) and the lowest (tying with Westmorland at 15) for journeys to school. (Table 6) This county also records the highest percentage uses of bus transport both during the week and at weekends (27 and 19 respectively, compared with 12 and 14 as the next highest respective percentages) (Table 5). Paradoxically, Kirkcudbrightshire ties with Banffshire for the highest percentage of households with private cars (48). (Table 1). The paradox may indicate, however, that many journeys are made by people without access to cars even if one is owned in the household. A common observation during interviewing was that families sometimes included sons of the 18 - 24 age bracket who had left school and worked on the farm, or on neighbouring land, or in town. Frequently they owned a car but it was not available to other members of the family. This observation, while incomplete, would contribute to the results of Table 6 and Table 1 in this Report and help to explain them.

14. Van retailing is a well-established form of countryside activity, and many interviewees noted in passing that vans had been calling for as long as they could remember. In particular, the postmistress at Stobo, who (one guesses) is approaching retirement age, recalled for the writer many incidents involving horse-drawn vans in the Peeblesshire countryside of her girlhood. For a specific enquiry of this subject in Scotland see Wheeler, P.T., "Travelling Vans and Mobile Shops in Sutherland", Scot. Geog. Mag., LXXVI, 1960, pp. 147-155, and for a much more comprehensive study in Finland see Helle, Reijo, "Retailing in Rural Northern Finland: Particularly by Mobile Shops", Fennia, 91, No. 3, 1964, Helsinki.

15. Christaller and others recognized the limitations imposed by considering the economic approach to the exclusion of others. But little effort has been made to date to incorporate into the theory explicit variations of approach involving concepts of geography, sociology, history, and political science. See Christaller, op. cit. Chapter 4, Part B, "Methodological Results for the Geography of Settlements".

16. To the extent that occupation identifies "class", the following

(b) The Study Area

The area selected for investigation comprises seven counties which, together, are commonly referred to as south-east Scotland. (Map 1) West Lothian, Midlothian, and East Lothian form a tier of three counties occupying the northern portion of the study area, while the greater portion is included in the Borders, made up by Peeblesshire, Selkirkshire, Roxburghshire, and Berwickshire. Separating the Lothians and the Borders are the Lammermuir Hills, the Moorfoots, and the Pentlands, individually oriented in a basic north-east to south-west direction, but collectively linked as high land stretching across the area in an arc-like pattern following a line from Cockburnspath in the east, south-west through Oxton and Eddleston, and swinging north-west to terminate at the Pentlands just above Carlops. Further high land defines the western and southern boundaries of the study area, the counties being demarcated along the watersheds. In the Cheviot Hills the county boundaries are formed by the English border which, in the eastern part, where the Cheviots taper off, swings north to follow the Tweed River. The northern and north-eastern limits of the study area are coastal.

While the overall shape of the area is compact, measuring approximately sixty miles in any direction, the presence of hills points to internal differentiations which pattern the activities to be observed. The higher lands both ring and separate the principal lowland regions, the Tweed Valley and the southern part of the Forth basin, where the main concentrations of population are found. ("Lowland" and "upland" may be distinguished approximately at the

1,000 foot contour line above sea level.) Streams flowing into the Forth or into the Tweed, however, occupy valleys which cut through the hills. Roads and railways parallel these streams thus binding together the lowland areas.

The main access into the study area by land includes not only the coastal lowland routes from the west into the Lothians and from the south into Berwickshire, but also the inland routes from the upper Clyde Valley into the upper Tweed along routeways fanning north-east and east from Biggar towards Edinburgh and Peebles respectively, from Moffat in upper Annandale north to Tweedsmuir and north-east into the Yarrow Valley, from Langholm into upper Teviotdale, and across the Cheviots at Carter Bar above Jedburgh. The main routes across the hills lying wholly in the study area are along the valleys marked by the A7 between the area known as the middle Tweed, centring on St. Boswells, and the Forth lowlands just south-east of Edinburgh. Additional links with Edinburgh exist from the upper Tweed via the A703 at Peebles, the A702 and the A701 which focus on Biggar, just outside the western limits of the study area. The lower Tweed Valley has access to the Forth lowlands via the A1 coastal route and the minor route of the B6355 linking Duns and Chirnside with Gifford and Haddington.

The lowlands of the Forth and Tweed, along with their tributary valleys, support virtually all settlement in the area. Thus the gross structure of settlement comprises an east-west zone flanking the Forth and a north-east to south-west zone, the Tweed Valley. As already described, these two zones are linked by a limited number of valley routes crossing the intervening uplands. There is considerable

movement along these accesses, not only because they interconnect the lowlands of the study area, but also because they are the main routes linking Edinburgh and much of Eastern Scotland with England. (1) The first two major centres in England to which these roads lead are Newcastle-upon-Tyne in the east and Carlisle in the west.

Major east-west movement occurs most notably in the Lothians: to the west of Edinburgh is the heavy traffic with Glasgow, and to the east the A1 brings the east coast traffic from England. Direct movement between Glasgow and Newcastle passes from the upper Clyde Valley into the upper Tweed past Peebles, and disgorges into the broad lowland of the middle Tweed at Galashiels to link up with the direct south-east route via Carter Bar. In the middle Tweed, then, movements along major routeways to Edinburgh, Glasgow, and Newcastle, and the traffic along the general north-east to south-west axis of the Tweed Valley, all meet in a broad zone of junction which distinguishes this central part of the study area for its overall accessibility to major cities.

In 1961, the year of the last full Census, the seven counties of the study area contained a total of 358,155 persons. This represents an increase of three percent over the 1951 figure of 347,395. While the total figure is not as important in this study as the manner of its distribution, it may be noted that it is only 76.5% of the population of Edinburgh (468,378) in 1961.

Map 2 shows the distribution of the dispersed population in 1961. The dispersed population is defined as the population residing outside central places of second order or higher, as recognized in Chapter II. (2) The common pattern of sparsely inhabited uplands

contrasting with more densely inhabited lowlands is immediately apparent, and the Lammermuirs, Moorfoots, Pentlands, and the high tributary valleys of the upper Tweed, stand out as areas of very low population density. These are the regions shown as having densities less than 9.0 persons per square mile.

The increase in population density away from these empty areas may be seen by crossing the isopleths. The gradient, inversely related to the topographic one, is steep to the major portion of the lower and middle parts of the Tweed Valley which is defined approximately by the 29.0 persons per square mile isopleth. Patches of territory around Duns, Kelso, the Melrose-St. Boswells area, and the south-east corner of Berwickshire near Berwick-on-Tweed, achieve densities of 46.5 persons per square mile. But these densities are slightly less than half those achieved in central West Lothian and Midlothian south-east of Edinburgh where they exceed 98.0 persons per square mile. The population density gradient is very steep from the hills to the south of Edinburgh, the highest densities in the Lothians being some eleven times those of the uplands. These differences in density emphasize the contrasts in settlement which are to be noted.

The distribution of the 1951 population is clearly accordant with that described for a decade later. (Map 3) The general pattern is much the same, as may be inferred by tracing the shapes of contour configurations. Particular similarities are to be seen in the configurations and positions of the 9.0 and 11.0 persons per square mile isopleths for 1961 and 1951 respectively. The isopleth which defines the main area of settlement in the Tweed Valley is that representing 28.0 persons per square mile. (3) Tributary valleys are not indicated

by this isopleth although Lauderdale and the small valleys above Duns are outlined by the next lower value isopleth, 19.0 persons per square mile. The Yarrow and Ettrick Valleys, above Selkirk, are not suggested with any strength until the isopleth having the lowest value, 11.0 persons per square mile, is reached.

The gradient north into the Lothians is the steepest on this map as well as on the one for 1961, and the greatest density exceeds 96.0 persons per square mile in a wide zone around Edinburgh from east of Tranent to the west, around Gorebridge, and to Bathgate, Linlithgow, and Bo'ness. This zone is more extensive than that shown for the highest densities in 1961 (98.0), and the uplands are seen to be more thickly settled in 1951 than a decade later. Thus two trends may be noted: during the decade an overall decline of the dispersed population may be observed while some localization of very high densities is apparent in West and Mid Lothian.

Tracing the contours on both maps reveals that some occupy virtually identical positions but carry different values. The 9.0 and 11.0 isopleths for 1961 and 1951 have already been referred to but the observation holds in tracing others, such as the 46.5 and 60.0 isopleths from east to west across the Lothians and in the Tweed Valley. Thus the overall decline of population varies in intensity from one or two persons per square mile to fifteen or more, often without any marked change in the relative distributions.

The patterns of change of population are shown on Map 4 by percentage. Apart from minor irregularities where increase is to be noted, such as in Forestry Commission Villages (Bonchester Bridge and Craik, near Hawick), and the three small areas of increase to the

south-east and south-west of Edinburgh, and in western West Lothian, the whole study area exhibits decline. Some of the hill areas do not show as great a percentage change as do some of the lowland zones because the population had already ebbed to the point of emptying large tracts of upland before 1951. Accelerated decline for this decade is to be observed instead in certain tributary valleys such as the Manor valley above Peebles, the small valleys above Duns and Hawick, and in various parts of the lowlands. If this trend is projected, the future should see an increasing localization of accelerated decline around those areas now most densely settled, with the exception of the zone surrounding Edinburgh. There, the concentration of growth is to be observed, and it may be noted that the growth areas lie astride two of the major corridors of access to and from the city.

It has already been noted that over the region as a whole the population increased during the decade. This is explained almost entirely by the increase in burghs and larger villages. The percentage change for all centres of second order or higher is shown at the location of the place on Map 4 (the hierarchy of central places is identified in section II(c)(i)). The increase of population in centres provides a complementary aspect to the picture of change noted for the dispersed population: there is a progressive nucleation of population. Centres increasing in size mainly cluster around Edinburgh and the middle Tweed region, with isolated examples of increases in towns along main highways (Ayton, Reston and Greenlaw in Berwickshire), and in centres where local authority housing has been built during the past decade (Lilliesleaf, Ancrum, and Yetholm in Roxburghshire), and in places with recreational attraction and within commuting distance to

Edinburgh (Gullane, Longniddry).

If burghs are classified into two groups, Levels A and B, based upon the relationship between their populations and community facilities in the mid-1960's, as outlined in section II(c)(i), the comparative changes in their burgh populations from 1911 may be seen to be consistent with this grouping. (Figure 1) Beyond a straight line radius of about 12 miles east from Edinburgh, only Haddington shows a notable increase. The only other Level B centre showing increase is Linlithgow, surrounded by Level A centres which, without exception, show increases during the 1951-61 decade. Musselburgh is the only centre in this group whose population increase is slight. Thus the overall picture is one of increasing concentration in villages and towns of the region and in the general vicinity of Edinburgh, while, simultaneously, decline is the trend of the dispersed population.

The patterns of livelihood in the study area vary considerably. In the Lothians, around Edinburgh, a distinctive and varied landscape tells the tale of many pursuits, both current and past. Farming and mining are traditional and obvious activities, the former being expressed in a landscape of fields, wind breaks, clusters of buildings housing the farmer or manager, the farm workers, machinery and animals, and a seasonally varying pattern of ploughed furrows, emerging crops, harvested fields, and pastures. The latter activity, mining, appears in places to be intruded into the farming landscape while, in others, it forms a dominant landscape of its own with an infrastructure of scaffold-like towers, railway lines and trucks, enormous bings dwarfing numerous groups of row cottages occupied by miners and their families either at present and certainly in the past. In addition to these

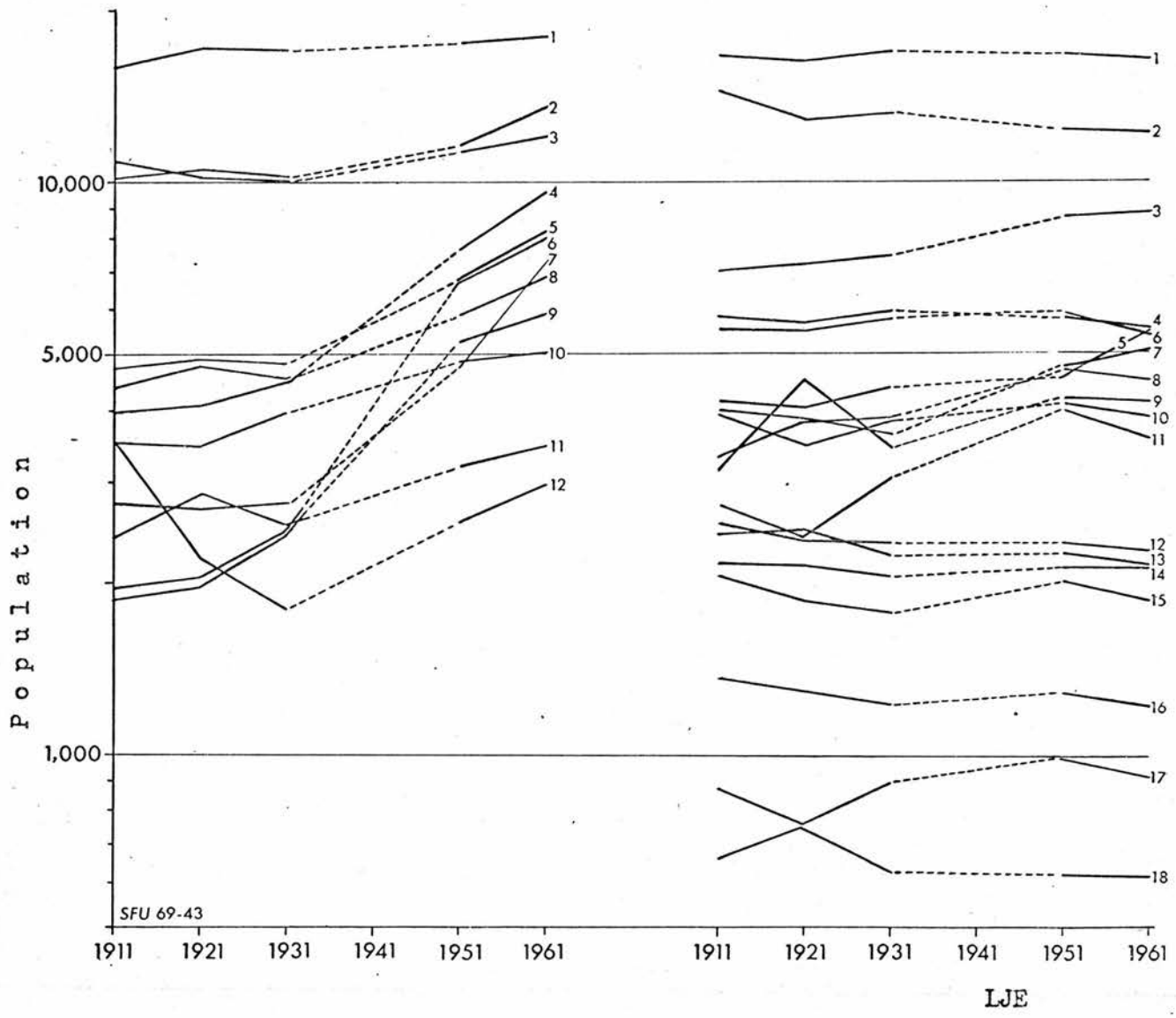


Figure 1 -- Comparative Decennial Changes in Burgh Populations, 1911 - 1961.

Numbers correspond to Burghs listed on the following page.

Figure 1: Numerical Identification of Burghs

Level A Centres

1. Musselburgh
2. Bathgate
3. Bo'ness
4. Bonnyrigg and Lasswade
5. Armadale
6. Prestonpans
7. Penicuik
8. Tranent
9. Whitburn
10. Loanhead
11. Cockenzie and Port Seton
12. South Queensferry

Level B Centres

1. Hawick
2. Galashiels
3. Dalkeith
4. Selkirk
5. Haddington
6. Peebles
7. Linlithgow
8. Dunbar
9. North Berwick
10. Kelso
11. Jedburgh
12. Innerleithen
13. Eyemouth
14. Melrose
15. Duns
16. Coldstream
17. East Linton
18. Lauder

traditional landscapes, a new one is emerging in this zone, that of the modern industry of which a good example is the B.M.C. plant on the outskirts of Bathgate. It occupies a relatively extensive but compact tract of land, enclosed by wire mesh fencing which allows a view into the property. The interior is occupied by paved parking areas where hundreds of gleaming tractors and other vehicles are stored, parking areas for workers' cars, prominent road access from the main highway, and a one or two storey building in the modern vogue of plant design where continuous horizontal movement demands large areas but little vertical space. This last landscape type is more compact and also more sharply demarcated than that of mining, and thus appears more distinctly embedded within the total. This relatively densely settled part therefore exhibits many forms of organization and bears traces of rapid shifts in the fortunes of various activities.

In some contrast, even the casual observer must be struck by the uniformity of landscape organization in the areas roughly east of Macmerry and Pencaitland, and south of Gorebridge and Penicuik. Beyond these areas, with isolated examples of industrial activity in the burghs, the broad sweep of landscape is agricultural, with individual farms, tenant farms, a few small-holdings, and some very grand estates being the main variations of organization. To some extent, forestry practices are modifying this pattern and examples of Forestry Commission activity are found at Glentress and Kirkburn east of Peebles, at Bonchester Bridge and Craik south-east and south-west of Hawick respectively, and in extreme southern Roxburghshire around Newcastleton. A prominent example of private estate forestry is to be seen in the Yarrow where the Duke of Buccleuch is devoting much attention and land to this pursuit.

The broad distribution of employment occupations provides a further and parallel perspective in this discussion of internal differences within the study area. Map 5 shows the proportions of employees, on a percentage basis, in each of four broad categories, by Ministry of Labour Employment Exchange Areas. (4) It may be seen that agricultural occupations do not figure prominently in any of the Exchanges west of Edinburgh, and the percentage is less than 10 in each of the Musselburgh, Dalkeith, and Loanhead Exchanges to the east. Other Exchanges have at least 10% employment in agriculture except Galashiels and Hawick, both of which centre on large towns (and Galashiels includes the other prominent centres of Selkirk and Melrose) but incorporate vast and empty uplands. In this they stand in contrast to neighbouring Exchanges which have up to 38% employment in agriculture as in the case of the Eyemouth Exchange.

Mining, as an independent category, is prominent in the Musselburgh, Dalkeith and Loanhead Exchanges which occupy the Midlothian Coalfield, and in the Bathgate and Bo'ness Exchanges. Elsewhere it is very low and numerically unimportant, leaving agriculture as the only important employer in primary activity.

Manufacturing, or secondary activity, bulks very importantly, falling below 20% in only four Exchanges, Tranent, North Berwick, Eyemouth, and Kelso and Jedburgh. Of these, Tranent is distinctive because its overall employment structure is heavily weighted towards tertiary activities and agriculture. Tranent, the home of the East Lothian Co-operative Society, is now the largest burgh in East Lothian and emphasizes the organization of services and goods on a large scale. Further, the Co-operative owns farms (the Windygouls, for example) which are labour intensive, contributing to the high figure for

agriculture. (5) All this stands in considerable contrast to past patterns when Tranent was the centre of the East Lothian coalfield which is no longer exploited.

If the number of persons engaged in agriculture , mining, and manufacturing give some indication of the market for goods and services required of central places, the numbers engaged in tertiary activities, those activities fulfilling this demand, reflect the total demand of all people in the centre in addition to those of surrounding areas. The importance of this sector of the economy of the study area may be gauged by the observation that all Exchanges have more than 25% employment in it. The lowest, Loanhead, at 26.7%, lies adjacent to Edinburgh whose Exchange has the highest percentage (70.7) engaged in this sector. The inference is clear that Edinburgh supplies many of the services used by people in the Loanhead Exchange area. Most other Exchanges count close to 50% or more of their employed people in this sector, implying that in the study area, large parts display the condition whereby about one half the employed provide services to the local inhabitants. A notable exception in the case of Hawick, where manufacturing is the dominant employer, may indicate something of the efficiency produced by population concentration; for although the Hawick area is large, it is relatively sparsely populated and most people live in Hawick itself, the largest burgh in the study area after Musselburgh. It may well be that the tight concentration of population permits a greater efficiency in service, allowing this centre, as a major central place on its own in contrast to Loanhead, to provide all necessary services with a low percentage of people employed in this sector.

The various landscapes and the varied distributions of occupational types provide two perspectives on the contemporary nature of the study area. The landscape, a peculiarly geographic concept, emphasizes the study of the effects of human life as they are worked out in environmental circumstances; the occupational structure shows, by its varied distributional characteristics, something of the contemporary orientations of human life. The three landscapes mentioned, the agricultural, mining, and contemporary industrial, exist in locational interrelationships but do not necessarily have direct functional interconnections. However, at a personal level, regardless of occupation or status, all the inhabitants of the area require basic necessities which are similar - food, clothing, education, household effects, and so on. While different economic pursuits may be expected to give distinctive characters to the centres as nodes of organization, therefore, it does not follow that this distinctive character necessarily carries through to pattern the personal service functions of central places. This enquiry looks into activities of the general public in relation to individual needs for goods and services and in relation to the expression of forms of collective behaviour which help to determine the nature of settlement in the study area. Therefore functional interconnections are to be expected at this level in and across all the various landscapes because they are seen in relation to interactions in the central places which service and organize the surrounding areas' activities. (6)

I(b) FOOTNOTES

1. Information on traffic volumes is based upon the Census of Trunk Roads, Scotland, August 1961, and the Census of Class I Roads, Scotland, August 1963, by the Road Engineers Department, Scottish Development Department. A map of traffic flows, compiled in the Road Engineers Department from Census returns, clearly shows the relationships indicated here.

2. In Chapter II the hierarchy of central places is determined by the ratio between the number of people and the number of functional facilities. Because first order places, the lowest in the hierarchy, are often straggling, scattered communities and frequently have only one or two facilities by which they are recognized as centres, their inhabitants are included here as part of the dispersed population.

3. The slightly different values of isopleths between the population maps for 1951 and 1961 are explained by their selection as shown in Appendix B, and as discussed in the following section of this chapter. The aim in the selection of all isopleth values is to identify the important groupings of data.

4. Percentages are calculated from the Ministry of Labour, Employment Record II, Estimated Numbers of Employees (Employed and Unemployed) in the Area of the Employment Exchange(s), June, 1964. The categories are the broad divisions of the Standard Industrial Classification, 1958 edition, as used by the Ministry of Labour in these records.

5. Information about the Co-operative was supplied by Mr. D. Sydserf, Transport Manager, East Lothian Co-operative Society, Tranent, September 4, 1964.

6. This reasoning, developed here with specific reference to south-east Scotland, is examined systematically in other contexts by Philbrick in "Principles of Areal Functional Organization in Regional Human Geography", Economic Geography, XXXIII, 1957, pp. 299-336.

(c) A note on Method and Terminology

This section is a general statement of the procedures followed and terms employed in this study. More detailed methodological considerations are most appropriately included in later parts where they form integral parts of the discussion.

Central place studies almost invariably demand field work in order to obtain data relating to functional structures of centres and their associated spheres of influence. This study is no exception. While larger centres were easily identified in published maps, Census materials and other records, small centres presented considerable difficulty, being finally identified after a thorough field inventory was carried out. Details of this aspect of field work are noted in Chapter II(a). Similarly, the functional structure of larger centres was worked out from published materials while that for small centres relied heavily upon field work. Thus both the identification and functional analysis of centres, especially the smaller ones, depend upon field investigations.

In order to assess the extent of influence of centres, interviews were conducted throughout the countryside. A preliminary questionnaire was drawn up and tested in East Lothian north of the A-1 during the spring of 1964; some twenty-one interviews were conducted by the writer.

The lessons learned from this test were incorporated into a new questionnaire; this especially meant allowing for specific questions concerning mobile shops. A test of the second questionnaire revealed that it was too lengthy, somewhat repetitive, and arranged in a poor format. About 100 were completed and returned through the post but this method of acquiring information proved unsatisfactory because of

the uncertainty of their return, especially as winter set in. It was decided, therefore to conduct all interviews personally and, in order that this procedure be expedited, a shortened version of the questionnaire was developed in an improved format without the loss of any questions for which information was readily available as shown in the pilot surveys. A copy of the questionnaire is included as Appendix A.

Interviews were conducted between May and October of 1965. In addition to the writer, the writer's wife and six third and fourth year undergraduates of the Geography Department, Edinburgh University also conducted interviews. All assistants had previous training in this type of field work and the quality of their work in this study is judged to be very high as the result of sample checks by the author in all areas covered by assistants. In all, 1,319 interviews were conducted or schedules received by post, having been completed by the respondent. Details of the survey, as they provide context for the identification of hinterlands, are included in Chapter III(a).

Mapping procedures include three general techniques requiring comment: isopleths, ray diagrams, and the construction of activity cones. The most involved concerns the construction of isopleth maps. The procedure outlined here is followed for all isopleth maps.

Three basic issues are involved in the construction of an isopleth map: the evenness of the distribution of reference points (the more even the better), the choice of isopleth values, and placing the isopleth. The interview locations do not have a uniform distribution (Map 6) and placing the isopleths thus becomes a matter of numerous irregularly-varying interpolations of position unless a technique is employed which overcomes the irregularities. Professor

J. A. Barnes outlines such a technique and the sequence of steps employed may be listed. (1)

1. The actual distribution of data is plotted.

2. A triangular grid is placed over the map (in the same position on all maps) and the grid intersections are used as reference points.

3. A circle, exactly circumscribing a triangle of the grid, is superimposed, centred on each grid intersection. This is described by Barnes as the "floating control area".

4. The distribution values falling within the control area are counted and entered as the value at the grid intersection, or control area centre. This provides a distribution of values uniformly spread. The triangular grid eliminates the problem of isopleth direction which occurs in squared grids where diagonally opposite points have equal value.

Having transformed the distribution into a uniform spread, the question of isopleth values arises. The method used in this study involves graphing the intersection values on a frequency histogram, and then entering running averages of adjacent columns on a second frequency histogram on semi-log paper to emphasize the troughs. The troughs are taken to indicate the important breaks in the data, and isopleths are given the values of the troughs. All histograms for maps in this study are contained in Appendix B. Having assigned values for isopleths, it becomes a matter of simple interpolation to place the isopleths on the maps.

The Barnes system of isopleth mapping has certain advantages. First, the problem of irregularly spaced values is eliminated. Second, the degree of generalization can be controlled because, as Barnes shows, the size of the control area governs the spatial generalization on the

map without any change in accuracy. The larger the control area, the greater the generalization; but the more generalized map is just as accurate as the more detailed one. In this study the control area is 17.5 square miles, the mean for all parishes in the study area. This area, taken as a circle, has a radius of 2.36 miles. This size is chosen because first order centres often appear to be parish centres, and the extent of their affiliations in the countryside seldom exceeds $2\frac{1}{2}$ miles in any direction. Further, the parish appears to be a significant area of identification for people in the countryside, to judge from their informal remarks. The isopleth maps in this study may therefore be said to be generalized to the level of the lowest order of centres in the hierarchy (as developed in Chapter II), and thus to provide a fairly detailed picture of the distributions shown. Because data values are centralized, they are necessarily transformed into ratios; persons per square mile is the simplest type but flexibility of mapping is enhanced by this method because ratios and changes between values of different maps may be calculated, as in Map 4, Percentage Population Change, 1951-1961. This flexibility is the third major advantage because it allows direct comparisons and correlations of distributions to be made. Advantages of the histogram method of determining isopleth values are that the number of isopleths chosen is not prejudiced, the data yielding up their own groupings, and important groupings on maps in sequence clearly indicate the nature of distribution changes.

Ray-diagrams are a conventional way of showing centralized contacts over areas. The technique is widely used in central place studies as well as other studies where contacts are to be shown. In

this study, where an interviewee indicates a contact with a specific centre for a specific purpose, a line is connected between the location of the interviewee and that centre. The ray-diagram is a configuration representing the aggregate of such contacts for a single purpose, and thus provides the basis for comment on group behaviour patterns with reference to central places, and for the internal delimitation of the study area by functional patterns.

Activity cones represent an extension of the ray-diagram. A concentric circular grid is placed over each ray-diagram and the frequency of occurrence of contacts at one mile intervals is counted in all directions. The sums of contacts for each interval may be graphed to provide a profile of spatial contact intensity. When applied to the area around the centre, this profile becomes a three-dimensional figure, the activity cone. Because the activity cone concept is elaborated later, further comment is reserved until Chapter III.

Already certain words have been employed which need clarification in this study. Although there is general agreement about the use of some terms in central place analysis, there is sufficient loose usage of terms to require specification of intended meanings. The following discussion is intended to clarify the more important terms as used in this study. Other terms of less general importance are discussed as they arise.

The term central place was coined by Christaller and is discussed above. But it is worth emphasizing here that Christaller saw this term in an abstract and general sense, implying that functional centralization is a social process of which locational effects are only

one set of manifestations. In the following discussions, the nouns centre and place are used interchangeably as short substitutes for the full term central place. The adjective central, as used by Christaller, thus carries the implications of the full term, although it is usually specific in its application as a modifier of good or service. Centrality defines the condition or quality implied by the existence of a central place, and it may be measured in various ways to indicate the degree of comparative attractiveness of central places in the overall centralization process.

The area surrounding a central place, if its inhabitants are attracted dominantly to it rather than to another centre, defines the complementary region in Christaller's terminology. Many substitutes exist for this lengthy term and, in practice, such terms as the following are commonly encountered: sphere of influence, community of interest area, hinterland, urban field, service and/or trade area, umland. In this study preference is shown for the term hinterland because of its common usage in this connection, a usage which exists in spite of its stricter definition as the complementary region for a port city.

In analyzing the centres of the study area, the functions were noted. These describe the types of activity carried on in centres, and are generalized into a functional classification. Individual outlets, establishments, or institutions are described as facilities; their numbers give some indication of the strength of various functions. In recognizing functions, it had to be kept in mind that only those to which access by members of the general public is possible were to be included. Thus the terms function and facility have more restricted meanings than in some studies where purely

"business-serving" facilities and functions are also included. Because the hierarchy of central places is identified on the basis of a relationship between population and facilities in centres (as developed in Chapter II) the hierarchy itself is therefore more specific in nature than is commonly the case in other studies where functions are not so restricted in meaning.

There is one sense, however, in which functions are much more broadly interpreted in this study than is usual. Although Christaller considers a central place in an abstract way, his application of his ideas is in the purely economic sense and this has been the tendency of students of this theory ever since. But the concept of the multi-purpose trip, implying the reduction of effort and the maximum use of time, both economic concepts, cannot specify whether all the purposes are economic. Some may well not be; to judge an economic versus non-economic distinction among functions thus carries inherent complications and contradictions. It is felt by this writer that the inclusion of all activity which centralizes personal spatial behaviour is logical, and that the limitation of functions to those serving the general public offers a different perspective with fewer ragged edges. It also implies that several of the well-established notions of central place theory must be tested here. These include the question of the derivation of a stepped hierarchy of central places, where all the centres are ranked by some scale of importance, and the nesting principle, where the functions of higher order centres in the hierarchy include all those of lower order centres.

Where functions are said to be open to the general public, this implies that individuals may participate directly. An interview in this study is conceived as representing the activity patterns for the household as well as for an individual. Thus personal or individual levels

of contact are construed to mean the same thing as household contacts and the words are used interchangeably.

This discussion is intended to sketch the main methodological approaches used in this investigation and to clarify the use of some key terms. The following chapters detail the principal analyses where more detailed methods and terms are discussed as appropriate.

I(c) FOOTNOTES

1. Barnes, J. A., "An Approach to More Effective Isopleth Mapping," Memorandum Folio, Southeastern Division, Association of American Geographers, Vol. XV, 1963, and "Isopleth Mapping at Large Scales," Ibid., Vol. XVIII, 1966.

   Discussions of some of the problems involved in isopleth mapping are found in Mackay, J. R., "Some Problems and Techniques in Isopleth Mapping", Econ. Geog., XXVII, 1951, pp. 1-9.

CHAPTER II

THE ANALYSIS OF CENTRES

(a) The Definition of Functional Centres

It is common for investigations into the functional structure of settlements to be limited to centres for which data are readily available in national censuses. In Britain this often means restricting the study to burghs and other nucleated settlements having 1,000 or more inhabitants. (1) In south-east Scotland, however, most of the functional centres are small (the largest, Musselburgh, comprised only 17,796 persons in 1961) and a majority are not listed separately in the Census of Population. The problem of identifying small centres, therefore, is one which needs specific attention in this study. First, it is necessary to decide what is a small functional centre and to specify how it may be recognized. Second, it is necessary to decide how small a place may be and still merit inclusion in this study. Third, all the functional centres of the study area must be located. These three problems are not essentially separate and are investigated more or less simultaneously.

In 1952 Carol recognized that the single farmstead in the Karroo represented the lowest order unit in the hierarchy and in 1957 Philbrick called this farmstead unit the basic one in his elaboration of the "principles of areal functional organization". (2) South-east Scotland is an area where such a point of view could be considered because the agricultural population is typically distributed in

isolated farm units rather than being concentrated in villages. However, this study is concerned with community activity at a level above that of the basic household where earning a living, chores, recreation and ritual would be the first points of analysis; the approach adopted here begins at the level of inter-personal (inter-household) co-operation where contacts between people are formalized either commercially, or for educational, religious, and recreational purposes. Therefore the farmstead is rejected as the basic settlement unit for study and attention is focused upon units where community activities typically concentrate.

The landscape of south-east Scotland is dotted with morphological indications of community activity. Among the easily identified are churches, schools, village halls, petrol stations, shops, and post offices. (A detailed analysis of functional characteristics of small centres is included in section II(d)). Many of these are recorded in large scale Ordnance Survey Maps, Gazetteers, County Development Plan Survey Reports, and the Index of Place Names. (3) But these combined resources are insufficient to provide a contemporary and definitive list of functional centres. A complete field inventory of centres thus became necessary for this study. Subsequently, each road in the area was travelled and the functional detail and spatial extent of small communities were noted. By this method the lowest order of functional centre was identified initially, and field notes were collated with information from other sources to provide the complete data on these centres used in this study.

The range of facilities noted in the field for small centres was remarkably broad. (Table 1) But it is impossible to say that every facility representing functional activity was observed. For

TABLE 1

FACILITIES NOTED IN FIELD SURVEY TO IDENTIFY FUNCTIONAL CENTRES

(a) Facilities representing foci of local community activity	(b) Facilities not included in the functional structure of centres
1. Baker	1. Adult education college
2. Bank	2. Agricultural engineer
3. Bootmaker	3. Bed and breakfast
4. Cafe and tea room*	4. Blacksmith shop
5. Coal and coke merchant	5. Bowling green
6. Draper and outfitter	6. Coast guard station
7. Filling station*	7. County Road Man's residence
8. Garage*	8. Forestry Commission Office
9. General shop	9. Golf course
10. Hall	10. Lifeboat
11. Hospital*	11. Old people's home
12. Inn, hotel, or public house*	12. Playing field
13. Insurance agent	13. Preparatory school
14. Joiner	14. Public conveniences
15. Kirk	15. Railway station
16. Knitwear shop	16. Tennis court
17. Police	
18. Post office	
19. Post office and general shop	
20. School	
21. Small contractor	

* - Facilities not in themselves sufficient to identify a functional centre. But where they occur in association with other facilities which define a centre, they are included in the functional structure of that place.

example, the blacksmith shop, once ubiquitous, now flourishes only in a few places such as Lindean, Midlem, and The Downs by Morebattle. Their prosperity rests primarily on the shoeing of riding horses for estates and, at Lindean, in the making of wrought iron furniture as well. Others may be operated on a part-time basis by an old man (the retired blacksmith) who sometimes runs a petrol pump as well. Examples of the latter are found at Stobo and Hallyne. Still others have deteriorated and are used only occasionally, as at Newbigging by Lauder. The task of finding and determining the status of all blacksmith shops in the area, therefore, would require a major effort beyond the scope of the present work.

Several other examples of functions excluded require explanation. There is only one Adult Education College in the area; it is located in Newbattle. Bowling greens, golf courses, and tennis courts, in contrast, are found commonly throughout. These functions were all dropped after a pilot interview survey revealed that not one person mentioned patronizing such functions. The decision seems justified in the light of the full interview programme because nobody ever did mention them. Perhaps the specification that interviewees should be "workers" wherever possible is relevant here and that golf courses etc. may have been referred to if persons interviewed had been from higher socio-economic levels. At any rate, in this study, these functions do not bulk at all importantly in the countryside. Agricultural engineers are excluded because they are more of a "business-serving" function rather than an individual- or household-serving one, and the settlement structure as it is used and formed directly by the general public is the object of analysis.

The criterion by which facilities were judged for notation in

the field is that they should provide a focus for local activity. It became clear that hotels, filling stations, and cafes, where they occur alone or in association only with each other, frequently are more dependent upon "passing trade" for their existence than upon local patronage. While the latter is sometimes a factor in their prosperity, the major impetus to the establishment of new filling stations, for instance, does not appear to be related to local markets or activity. (4) Therefore, places recognized solely on the basis of these facilities have been excluded from the list of functional centres. Where a centre may be recognized by other functions, however, then these are included as functional characteristics of the centre where they are found.

The examples and modifications detailed here indicate the necessity to pare down the original list of 37 types of functions noted. The final list of functions considered is shown in Table 1, Column (a); those functions eliminated are given in Column (b). It is believed that this list of functions for small centres provides the basic framework for locally oriented activity which is meaningful for this study. A complete list of centres identified for inclusion here is found in Appendix C.

II(a) FOOTNOTES

1. See, for example, Fleming, J. B., "An Analysis of Shops and Service Trades in Scottish Towns," Scot. Geog. Mag., LXX, No. 3, 1954.

2. Carol, Hans, "Das Agrargeographische Betrachtungssystem. Ein Beitrag zur Landschaftskundlichen Methodik dargelegt am Beispiel der in Sudafrika," Geographica Helvetica, I, 1952, pp. 17-67.

   Philbrick, Allen K., "Principles of Areal Functional Organization in Regional Human Geography", Econ. Geog., XXXIII, 1957, pp. 299-336.

3. Johnston's Gazetteer of Scotland, Including a Glossary of the most common Gaelic Names. Revised by B. B. Hartop, A.C.M. and M. Rodger, W. and A. K. Johnston and G. W. Bacon Ltd., Edinburgh and London, 2nd ed., 1958, 248 pp., + viii and maps.

   An enquiry regarding the entry for Auchendinny in this Gazetteer was answered by Mr. A. C. M. Rodger in a communication dated January 4, 1964. "...The population for Auchendinny was deleted as it was not given in the 1951 Census of Scotland the settlement being neither a burgh nor a community of over 1,000 people..." This detail, giving the source of information, indicates that Gazetteers are unlikely to provide basic detail on a sufficiently wide scale to be reliable sources in this study.

   County Development Plan, Survey Reports, were produced in the County Offices for each County between 1953 and 1959. Reports generally contain a "Table of Community Facilities". While good in certain respects, three factors limit the usefulness of these Reports. One is the very uneven quality of inventory and analysis from Report to Report. The second refers to the problem of their comparability since six years elapsed between the completion of the first Report (East Lothian) and the last (Berwickshire). Third, comparability is reduced because the East Lothian and Selkirkshire Reports do not contain the "Table of Community Facilities".

   In 1951 the Index of Place Names was published as a mimeographed list showing the population of all identified places in Scotland provided the number of people was at least 25. This publication was compiled at Register House in Edinburgh from Census returns. In 1961 the basis for inclusion of population shifted from a population minimum to a settlement minimum characteristic: where five households were grouped together as a settlement unit as interpreted by the Census enumerator, the population was recorded in the Index. The full reference for the final publication for 1961 is: Scotland, General Registry Office of Births, Deaths, and Marriages. Place Names and Population, Scotland: An Alphabetical List of Populated Places Derived from the Census of Scotland, Edinburgh. HMSO, 1967. 190 pp. Tables.

4. This information was informally acquired from service station operators who claimed that "passing trade" was their mainstay.

(b) The Functional Classification for Centres

The classification of functions is based upon an assessment of facilities available to individuals and households. Therefore business-serving facilities, such as wholesaling or manufacturing, are not included. This is not intended to deny their importance but rather to maintain consistency of approach in this essay where the object of analysis is the settlement hierarchy as it is used and formed directly by the general public.

The major source of published data used is the Classified Telephone Directory of Trades and Professions, Edinburgh Area, March, 1964, published by authority of the Postmaster General. The "Edinburgh Area" as defined by the General Post Office comprises all seven counties of south-east Scotland except a narrow north-south strip of western Peeblesshire, the Roxburghshire portion of Liddesdale (Castleton Parish) and a small corner of south-east Berwickshire. Thus the data pertaining to Broughton, Skirling, and Tweedsmuir in Peeblesshire, to Newcastleton in Roxburghshire, and to Foulden, Hutton, Paxton, Clappers, and Ladykirk in Berwickshire, are gathered from other sources including the County Development Plan and Survey Reports published between 1953 and 1958, numerous trade and professional directories, and the field investigations already described.

The number of categories of trades and professions used in the Classified Directory is 442. This number is not only unwieldly for this study, but also includes types of facilities which are not directly available to individuals; further, a number of duplications such as "cleaners" and "dyers and cleaners" are contained within it. Where such duplications occur, they are combined into one, more

inclusive, Category.(1) In a number of cases where only one or two entries appear in a Directory category, field work and other data sources show this Directory to be incomplete. Where satisfactory supplementary information is not available, such categories have been excluded to avoid the risk of distorting results as far as possible.(2) In general, however, the Directory is a very good source of data, especially for retail facilities. The consistency of results which emerge later in this essay supports the claim for the overall high quality of this source.

The principal method of coping with the large number of categories is by generalizing them into more inclusive Categories. This grouping is the classification of functions presented and used in this study and the numbered components, as in Table 2, are the Categories of the functional classification; these are sometimes identified by number in subsequent analyses.

The classification passed through several stages in its derivation. The basic model followed was the classification of retail and service trades developed by the Board of Trade for the 1961 Census of Distribution.(3) During the assignment of categories from the Classified Directory to the headings of the model classification, however, numerous problems arose which were solved in part by referring to an earlier working paper of the Board of Trade which was preparatory to the 1961 Census of Distribution.(4) In particular, the lack of categories relating to the wider spectrum of personal services was a problem, as was the absence of any attention to such considerations as education, religion, and administration.(5) The classification of the Census is not faulted here, of course, because their interest was limited mainly to retail considerations. In the event, however, the implication

TABLE 2

FUNCTIONAL CLASSIFICATION FOR SETTLEMENTS

IN SOUTH-EAST SCOTLAND

I Retail

1. Food
2. Confectioners, Tobacconists, Newsagents
3. Apparel and drapery goods
4. Hardware
5. Electrical goods and household appliances
6. Booksellers and stationers
7. Chemists and photographic goods
8. Cycles and cycle accessories
9. Furniture and music
10. Jewellers, leather, sports and fancy goods
11. Department and variety stores
12. Household fuel merchants
13. Other retail

II Services

14. Restaurants, cafes, hotels, public houses and roadhouses
15. Personal services
16. Building trades and materials; household and property maintenance
17. Public assembly halls; entertainment centres
18. Motor trade establishments
19. Medical, health, and social services
20. Professional services other than medical
21. Educational and religious institutions
22. Offices of local government, public administration, and law enforcement
23. Financial institutions and services
24. News services

was that several new Categories had to be created. These comprise those of the Services section of the classification presented here.

Several modifications of the classifications were made during the course of its derivation. These include combining all food retail facilities into one Category whereas the Census separates "Grocers and provision dealers" from all others dealing in food distributions. Further, "Hardware", "Electrical goods and household appliances", "Cycles and cycle accessories", and "Furniture and music", are considered here as separate Categories because they appear to be of quite different hierarchical orders; this becomes important in an attempt to describe the hierarchy of small centres. These four Categories are incorporated within one in the Census. Another broad Census category is split into three in the present study, involving "Booksellers and stationers", "Chemists and photographic goods", and "Jewellers, leather, sports and fancy goods". Other Categories remain the same except that "Other retail" is separated from "Department and variety stores", and "Household fuel merchants" is added.

As implied already, the classification finally developed is divided into two principal parts, Retail and Services. The number of Categories totals twenty-four, with thirteen being under Retail and the remainder under Services. The functional classification as outlined here forms the framework for listing facilities in each centre and for the functional characterization of each. Table 2 indicates the Categories of the classification; the components of each are included in the full outline of the classification in Appendix D.

II(b) FOOTNOTES

1. For both clarity and economy of expression, wherever Category is shown capitalized, it is understood to refer to the functional classification categories developed in this study. Where the word is used in conjunction with "functional" or "functional classification" and the descriptive sense indicates clearly that it refers to this study, it is not capitalized. Outside this specification, the use of the word is not precluded in other ways.

2. Such supplementary information, such as is contained in various professional directories, is applied to all Categories and not simply to those where the entries appeared low. This demonstrates that the assumption is not made that more than one or two entries in the Classified Telephone Directory implies a complete record; rather, the number of entries, if not suspiciously low, and if not augumented or confirmed from other sources, is merely taken to be as practicable a quantity as it is possible to achieve for this study.

3. Board of Trade, Report on the Census of Distribution and Other Services, 1961. Part XIII, Area Tables, Scotland. London, HMSO, 1964.

4. Board of Trade, Statistics Division, Britain's Shops: A Statistical Summary of Shops and Service Establishments, London, HMSO, 1952.

5. Only Hairdressers and Boot and shoe repairers are recognized as Service Trades in the Census of Distribution, 1961, for Scotland. An earlier report promised that the following would be distinguished: men's hairdressers; men's hairdresser-tobacconists; women's hairdressers; men's and women's hairdressers; boot and shoe repairers; laundries; laundrettes; dry cleaners. See Board of Trade Journal, 8 February 1963, "Census of Distribution and other Services for 1961", First Results. Even this extended list merely particularizes what was later published, and is of little benefit here.

(c) An Hierarchy of Functional Centres

(i) Derivation of the Hierarchy

In recent years studies of settlement systems have tended to note that an hierarchical arrangement of groups of centres may be observed when all centres are ranked by some measure of importance. Typically, population and/or functions have been used to measure importance either by the magnitudes of these variables or by key indices with imputed significance.(1) (2) In this section the relationship between population numbers (magnitude) and the number of facilities of centres (magnitude) is examined to establish the nature of an hierarchical arrangement if the system of settlement in south-east Scotland exhibits one.(3) Although an hierarchy of settlements may be assumed, it is necessary, as a preliminary in analyzing its nature in the study area, to determine whether it is stepped or whether the settlements form a continuum.

Olsson, in his review Distance and Human Interaction, contends that the argument as to the existence of a stepped hierarchy or a continuous rank-size distribution of places has only recently been resolved and, even now, it is not fully accepted that stepped hierarchies are universally found.(4) While the argument for the existence of a stepped hierarchy has been outlined theoretically and tested empirically, the opponents of this argument point to examples of rank-size distributions which cannot be conceived as hierarchical and which tend to invalidate the theory.(5) No theoretical statement has yet supported the rank-size distribution but the "observed regularities" have been impressive. Beckmann, in 1958, showed the correctness of the rank-size rule and a connection with central place theory, and the

general practical conclusion which appears is that an hierarchical structure characterizes small universe systems of places whereas continuous distributions appear where more than one system is considered at once. This appears intuitively correct and is the burden of the conclusion in Berry and Mayer where more than one system of places is studied.(5) However, Olsson significantly points out that several scholars are sufficiently dubious about the resolution of this controversy that they have attempted to circumvent the problem by using probability concepts to assign ranking by magnitude.(6) While it is not the purpose here to attempt a final clarification of this whole matter, the problems raised demand that the existence of a stepped hierarchy or a continuum must be identified in any area before further characteristics may be explored. The existence or non-existence of a stepped hierarchy would lend the weight of empirical findings for this study area to one or the other viewpoint.

A second reason why the hierarchy concept should be explored carefully here is due to the specialized nature of the data employed. It was pointed out in Chapter 1 that data for this study, as it relates both to activity and functions, is restricted to a personal or household level. This is a tighter and more restricted view of the possible data relating to the functioning of the settlement system than has been applied elsewhere. There is no way of predicting any effects this data definition may have upon the character of an hierarchy.

A third reason for this first step is that the relationship between numbers of people and facilities is the key criterion here and not simply population, or number of facilities, or a comparison between the two. This leads full circle to the reason for the attempt

to establish whether or not the hierarchy is stepped, and that is, of course, to explore its characteristics in this area as one aspect of the analysis of central places.

The relationship between the populations and number of facilities in centres is shown graphically in Figure 2. The overall distribution indicates a fairly close relationship in changing magnitudes; as population increases, so the number of facilities increases. At the lower end of the distribution a relatively large number of dots, representing the large number of small places recognized, cluster in rather formless fashion. The numbers thin about one third the way up the distribution, however, and increasingly, small identifiable clusters may be recognized. In order to highlight this tendency both the first and second "nearest neighbours" for each dot are joined and this produces the configurations of Figure 2. In general these configurations appear elongated along the axis of the distribution although this observation does not hold specifically at the lower end. Further, they tend to form closed clusters of points with various degrees of extension or length.

In order to examine this graph for evidence of an hierarchical structure, an imaginary line may be traced around the outer limits of the distribution. This line alternates from bulges around clusters of dots to constrictions between the configurations. Where the outline constricts in hour-glass fashion, groupings of dots and configurations are set apart on the graph, reflecting the ranks which the centres assume on the basis of graphical position. Graphical position is the defined relationship between population and number of facilities.

It is stated above that the character of the distribution is relatively formless at the lower end. Moving upward along the graph the

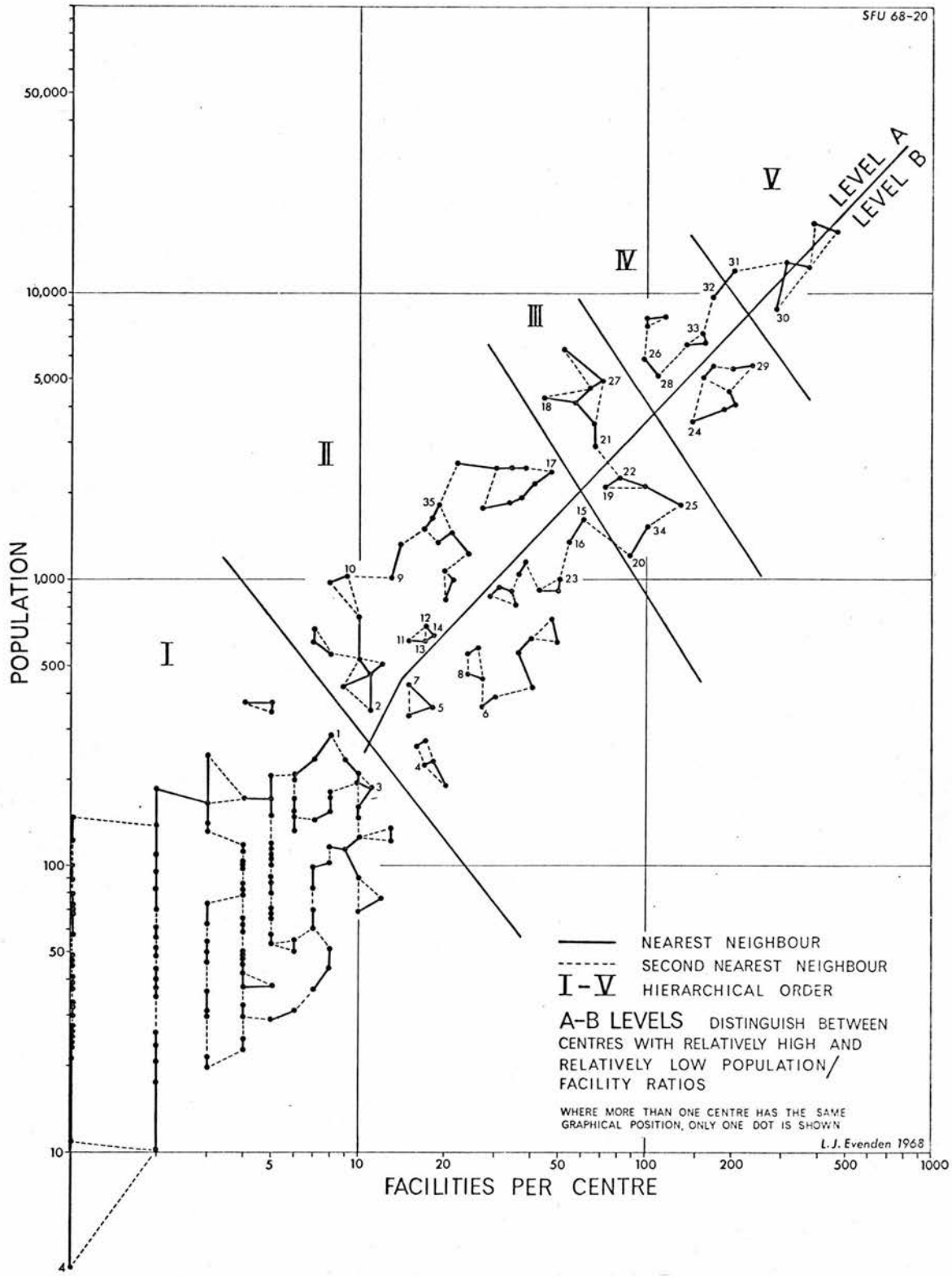


Figure 2 -- Relationship Between Population and Number of Facilities in Centres
Numbers correspond to places listed on next page.

Figure 2: Numerical Identification of Centres

1. Burnmouth
2. Philpstoun
3. Paxton
4. Morebattle
5. Gordon
6. Reston
7. Newbridge
8. Gifford
9. Bridgend
10. Seafield
11. Kirknewton
12. Dirleton
13. Pencaitland
14. Aberlady
15. Gullane
16. Earlston
17. Uphall
18. Blackburn
19. Eyemouth
20. Coldstream
21. South Queensferry
22. Innerleithen
23. St. Boswells
24. Jedburgh
25. Duns
26. Whitburn
27. Newtongrange
28. Loanhead
29. Haddington
30. Dalkeith
31. Bo'ness
32. Bonnyrigg and Lasswade
33. Penicuik
34. West Calder
35. Polbeth

first major constriction comes in the vicinity of Paxton (3) and Morebattle (4). This is the first recognizable gap across the distribution and is an obvious place to divide it. The nature of the differences between centres lying on opposite sides of the division may be illustrated with reference to the functional structures of Philpstoun (2) and Burnmouth (1). Philpstoun displays more variety in a fuller range of functions than does Burnmouth. Whereas they are each represented in functional Categories 1 (Food), 17 (public halls), 18 (motor trades), 21 (educational and religious institutions) and 22 (offices of local government, public administration, and law enforcement), Philpstoun is represented additionally in 3 (apparel and drapery), 16 (building trades etc.), and 19 (medical, health, and social services). In total facilities Philpstoun, with eleven, exceeds Burnmouth by two; and in population in 1961 Philpstoun, with 352 is greater than Burnmouth by 71. A relevant point here is the locational difference between these two places. Whereas Philpstoun lies on an important secondary road in West Lothian, and is frequented by buses connecting routes in all directions, Burnmouth is very awkwardly split between the settlement which has formed about the railway station, the junction of the A1 (T) and the A1107 routes, and fishing and residential communities which lie at the foot of the cliff some 300 feet below. In the definition of Burnmouth as a centre, the "communities" of Partanhall and Cowdrait are included with Burnmouth and this adds 96 (35 + 61 respectively) to the population as well as one retail food facility. An extremely tortuous access road down the cliffside connects Burnmouth with these other sections, and about half way down this road, as if to symbolize the connection, is the small

kirk, built upon the only level place to be found along the access. However, the practical functional connections between these two parts are minimal from the point of view of servicing surrounding areas, for the people living at the foot are chiefly engaged in fishing and contribute little if anything to the central place activities of the community above them; Burnmouth would appear less important as a central place than the population/facility relationship at first suggests. Therefore it is concluded that, although Burnmouth and Philpstoun are the closest two centres across the gap separating them in Figure 2, they are nevertheless clearly of a different character. A division of the graph along the axis of the line shown recognizes this difference and separates the first order centres below it from the second order centres above.

Moving upwards along the trend of the distribution a "bight" in the imaginary outline occurs along the lower side and points up the possibility of a division by a line passing between Gordon (5) and Reston (6), and Newbridge (7) and Gifford (8). The following discussion refers to the question of a division of the distribution at this point. The constriction in the outline on the underside is not matched by a significant constriction on the upperside. This means that a strong case must be made for the comparative importance of Bridgend (9) over Seafield (10) (West Lothian) in order to justify a division here. Bridgend and Seafield have 13 and 9 facilities respectively, but Bridgend's functions are only one greater in variety than Seafield's, 7 against 6. It cannot be said that Bridgend encompasses all the six functions performed by Seafield, for the latter is represented in Category 2 (confectioners, tobacconists, newsagents) whereas the former

is not. From this it is not possible to say that Bridgeend is functionally very superior to Seafield.

Glancing upwards along the distribution several constrictions in its shape are to be noted and the general question arises as to how many hierarchical groups are to be recognized. In a larger framework, Philbrick suggests a seven-tiered hierarchy encompassing farmsteads at one end of the range of settlements and world cities such as New York at the other. (7) While it is true that such a generalized scheme need not impose any constraints of precedence at the scale of analysis of this study, it must be kept in mind that too fine a break-down of hierarchical levels here may reflect little more than minor deviations from a population-facilities relationship which, if there were more centres considered (from all of southern Scotland for example), would obscure the deviations by the assertion of the more general relationship. To say this is to speculate upon the effects of the size of the universe being considered; but to exclude the possibility of unknown effects due to the scale of the data universe would be both naive and misleading.

The configurations on the graph yield one more observation which makes it difficult to divide the distribution at this point. Lying directly astride the general path of such a division is a small, self-contained configuration representing the positional relationships among Kirknewton (11), Dirleton (12), Pencaitland (13), and Aberlady (14). While this is not to say that a division could not be drawn which would pass this configuration, its presence across the general area of a division, at the same time being surrounded by much open space on the graph, leads to a cautious appraisal of dividing the

distribution at this point.

To sum up the points relating to a possible division of the distribution between Gordon (5) and Reston (6) and between Seafield (10) and Bridgend (9), it is noted that: (a) the general distribution does not show a symmetrical constriction in outline at this juncture; (b) Bridgend is not notably more important that Seafield on a functional basis; (c) the possibility of minor irregularities in the number of facilities noted makes one cautious about insisting upon a fine textured division; (d) a small configuration comprising four centres lies across the general path of a division. While none of these points is conclusive individually, together they seem to provide the basis for a decision against a division of the distribution at this point; the constriction of the outline of the underside does not appear to warrant a full division in the face of these other considerations.

The next constriction of the outline occurs on the underside where Gullane (15) and Earlston (16) may be noted as reflexive nearest neighbours, and on the upper side between Uphall (17) and Blackburn (18). There seems to be little need to justify a division on the upper side because the configurations are quite widely separate. However, on the lower side any division must separate Gullane (15) from Eyemouth (19) and Coldstream (20) to which it is connected in second nearest neighbour relationships. Two alternatives to this division may be explored. First, the division may pass between South Queensferry (21) and Innerleithen (22) or, second, may be bent to pass between Earlston(16) and St. Boswells (23). (A third possibility would divide Gullane (15) and Earlston (16) but because these are each other's nearest neighbour and because other alternatives exist, this course is not considered).

The first alternative is rejected here on two counts: (a) the division would bend sharply in orientation so that it paralleled the abscissa of the graph and thus the division would be based more upon pure population values rather than upon the relationship between population and facilities and, (b) the division would join indentations which are not properly opposed in the outline of the distribution. The second alternative is rejected analogously because the division would parallel the ordinate of the graph very closely and would therefore be based upon the relationship among facilities only, with little reference to the relationship of facilities with population. Further, the number of facilities separating St. Boswells (23) from Earlston (16) is only 4 (or an 8% difference between them) and to divide on the basis of such a fine measure would seem inappropriate. Having rejected these two alternatives, the division as shown becomes not only the one possible choice but also separates places with the widest discrepancies between them and does so on the basis of the population-facilities relationship. This division separates those centres designated second order from those above them.

Between Jedburgh (24) and Duns (25) the distribution outline indents deeply and is complemented on the upper side by a sharp dip between Whitburn (26) and Newtongrange (27). In the area of this constriction the configurations of dots leave the space across the distribution entirely open and a division separating third order centres from those above appears obvious. No other alternatives present themselves here and thus a line passing across the distribution divides Duns (25) from Jedburgh (24) and Newtongrange (27) from Loanhead (28) and Whitburn (26).

Finally, a prominent constriction appears between Haddington (29) and Dalkeith (30) on the lower part of the distribution and the question arises as to what division, if any, should be applied. A division between Bo'ness (31) and Dalkeith (30) is rejected for the same reason as put forward for not dividing St. Boswells (23) and Earlston (16) - it would be predicated disproportionately upon the facilities data. Also, a line separating Bonnyrigg and Lasswade (32) from Penicuik (33) would parallel the abscissa and thus emphasize population. But there are other reasons. Bonnyrigg and Lasswade (32) with 169 facilities exceeds Penicuik (33) by only 12 (or 7.6%) whereas Bo'ness (31) exceeds Bonnyrigg and Lasswade (32) by 31 facilities (or 18.3%). Functionally, all three places are represented in 21 out of 24 categories but Bo'ness (31) is the only one represented in Category 24 (news services), implying its central importance as a collection and distribution point for information; this would seem to be a significant indication of its superior status. It may be that this difference is due to a locational factor inasmuch as Bo'ness (31) is removed from Edinburgh by some 18 or 20 miles whereas the burgh of Bonnyrigg and Lasswade (32) lies adjacent to Edinburgh and increasingly is becoming "suburban" to the larger centre. Finally, it takes the combined heritage and growth of two adjacent communities united under one administrative framework to account for the position of importance which Bonnyrigg and Lasswade (32) seems to command and this detracts from the thrust of it as a regional centre. In summary, a division of the distribution appears necessary to separate Haddington (29) from Dalkeith (30). Bo'ness (31) and Bonnyrigg and Lasswade (32) are more widely divergent in population-facilities characteristics than are

Bo'ness (31) and Dalkeith (30) or Bonnyrigg and Lasswade (32) and Penicuik (33). Thus a division separating Bo'ness (31) from Bonnyrigg and Lasswade (32) sets apart the fourth order centres from the final group comprising those places designated fifth order.

Based upon the analysis of graphical position relating magnitudes of population and the number of functional facilities, the centres are divided into five hierarchical groups designated as first order for the least important through fifth order for the most important. These groups will be referred to as (hierarchy) Groups I, II, III, IV, and V.

Further inspection of the distribution of points on Figure 2 reveals a general gap, running parallel with the trend of the scatter, and separating configurations on the upper and lower sides of the distribution. This gap is particularly prominent through Groups II, III, and IV but is not apparent among the centres of Groups I and V. An examination of which centres lie above this break and which are characterized by high population per facility ratios, reveals that virtually all of these centres are located in the Lothians and many of them have a history of mining. Those centres lying below the break, however, having lower population per facility ratios, are generally centres of the Borders and the dominantly agricultural parts of the Lothians with few exceptions. The most notable example of such an exception is West Calder (34) whose position is well below the dividing gap. There has been a serious problem of subsidence in West Calder which has prevented much expansion and Polbeth (35) has been developed nearby to facilitate the housing and re-housing of West Calder's inhabitants. This development marks a fission of the centre

into two and, although in many ways Polbeth's inhabitants may still identify with West Calder, and although West Calder remains the main functional centre, the provision of new functional facilities in Polbeth is the basis here for considering it to be a separate "daughter" community.(8) Polbeth (35) itself has a high population per facility ratio and lies in the upper side of the distribution of places on Figure 2 but, if considered together with West Calder (34), the unit would still lie in the lower part of the distribution. This serves to demonstrate the strength of West Calder as a "hinterland serving" centre in contrast to most of the settlements in the vicinity; but it should be noted that West Calder lies on the southern fringe of the main populated areas of the western Lothians and serves the hill farm areas which surround it to the south.

From the foregoing it appears that the nature of the division observed on the graph is reflected in the geographical realities of the study area and thus it is considered important to separate the places into upper and lower "levels" designated here as "A" and "B" respectively. (9) The distribution of the "A" and "B" Level places is highlighted on Map 8 by a dashed line which essentially divides the study area into A and B parts. A limited number of exceptions occur in the cases of Linlithgow, Newbridge, and Walkerburn. Level A centres are characterized by high population per facility ratios whereas Level B centres are distinguished by their low ratios. The distinction into levels for Group I centres is not drawn because these centres display no comparative distinctions among themselves which are reflected in the population/facility relationship. At the upper end of the hierarchy the distinction is also weak and Group V centres are

evidently large enough to produce fairly similar patterns of this relationship. However, the difference between Bo'ness and Dalkeith is instructive.(10) The latter exceeds the former in the number of facilities by 81 (or 40.3%) while the former exceeds the latter in population (1961) by 2,074 (or 23.2%). Thus the difference between them in "hinterland serving" activities may be inferred as very great. This inference was supported contemporaneously with field work which relates to the analysis in the following chapter. It was clear during field investigations that the reach of Bo'ness beyond itself was severely curtailed not only by the Firth of Forth on one side but also by competition from Falkirk, Linlithgow, and South Queensferry on other sides. Thus the close mesh of settlement in the area around Bo'ness limits its influence in a way that is not apparent for Dalkeith which is able to serve a considerable area to the south of it. Similar observations may be made regarding the spatially restricted contacts of Bathgate and Musselburgh when compared with Galashiels and Hawick. This is consistent with locational characteristics, with Bo'ness, Bathgate and Musselburgh all lying within the area dominated by level A centres in contrast to Galashiels and Hawick which lie in the area of level B centres; Dalkeith causes an identation of the boundary between these two areas. The characteristics of high population per facility ratios, limited areas of contact, and location thus serve to distinguish Bo'ness, Bathgate, and Musselburgh from Dalkeith, Galashiels, and Hawick. Accordingly, the division of the centres into Levels A and B is extended to the group V centres in the hierarchy.

(ii) Relationships between population and number of facilities by hierarchy groups and levels

Data showing various relations between groups and levels of the hierarchy are set out in Table 3. Characteristics of the hierarchy taken as a whole are shown in Columns 1 through 4. The total number of centres, shown in Column 1, are 172, 65, 13, 17, and 6 in ascending hierarchical order. The ratios among the numbers in each order are 0.4, 0.2, 1.3, and 0.4 respectively. (To avoid redundancy, only one set of ratios is referred to in the text at a given point although both sets may be equally appropriate; at this point Rows bearing odd numbers are indicated.) Population characteristics are shown in Column 2. The mean number of persons in each hierarchy group is 80.2, 977, 3,251, 6,107, and 13,436 whereas the respective ratios among these figures are 12.2, 3.3, 1.9, and 2.2. In Column 3, the numbers of facilities in all places are recorded. The mean numbers, moving upward through the hierarchy again, are 3.9, 25.4, 76.5, 155.5, and 331.8. The ratios among these are 6.5, 3.0, 2.0, and 2.1. It is recalled that the data used are limited to those facilities relating directly to personal activity and hence the hierarchical relationships drawn here - except for population (Columns 2, 6, 10) - is a special aspect of the more general case where the whole functional structure of the centre would be considered. The relationships are therefore those of a modified type of hierarchy.

The ratios indicated here for these data display certain regularities, although there is divergence from classical central place theory concerning numerical relationships in the hierarchy. A tendency to a 1:3 ratio between centres may be noted between Groups V and IV (Columns 1,5,9), but this conformity with Christaller's "market principle" ratio is repeated again only between Groups II and I. Between Groups IV and III approximately a 4:3 ratio downwards in all "C" columns characterizes the hierarchical

TABLE 3

DATA AND RELATIONSHIPS BETWEEN POPULATION AND NUMBER OF FACILITIES

Row	Column No.	Total 1 C	Total 2 P	Total 3 F	Total 4 P/F	Level "A" 5 C	Level "A" 6 P	Level "A" 7 F	Level "A" 8 P/F	Level "B" 9 C	Level "B" 10 P	Level "B" 11 F	Level "B" 12 P/F	Ratio "A" to "B" 13 C(A)/C(B)	Ratio "A" to "B" 14 P(A)/P(B)	Ratio "A" to "B" 15 F(A)/F(B)	Ratio "A" to "B" 16 14/15
	Group V																
1	Total	6	80,614	1,991	40.5	3	42,770	893	47.9	3	37,844	1,098	34.5	1	1.1	0.8	1.4
2	Mean		13,436	331.8	40.5		14,257	298	47.9		12,615	366	34.5				
3	Ratio V/IV (means)	0.4	2.2	2.1		0.3	2.0	2.3		0.4	2.6	2.0					
4	Ratio IV/V (means)	2.8	0.5	0.5		3.0	0.5	0.4		2.7	0.4	0.5					
	Group IV																
5	Total	17	103,823	2,643	39.3	9	65,472	1,151	56.9	8	38,351	1,492	25.7	1.1	1.7	0.8	2.2
6	Mean		6,107	155.5	39.3		7,275	128	56.8		4,794	187	25.6				
7	Ratio IV/III(means)	1.3	1.9	2.0		1.3	1.6	2.1		1.3	2.6	2.0					
8	Ratio III/IV (means)	0.8	0.5	0.5		0.8	0.6	0.5		0.8	0.4	0.5					
	Group III																
9	Total	13	42,259	994	42.5	7	31,068	420	74.0	6	11,191	574	19.5	1.2	2.8	0.7	3.8
10	Mean		3,251	76.5	42.5		4,438	60	74.0		1,865	96	19.4				
11	Ratio III/II (means)	0.2	3.3	3.0		0.2	3.6	3.1		0.2	2.8	3.0					
12	Ratio II/III(means)	5.0	0.3	0.3		5.0	0.3	0.3		5.0	0.4	0.3					
	Group II																
13	Total	65	63,530	1,649	38.5	35	43,785	683	64.1	30	19,745	966	20.4	1.2	2.2	0.7	3.1
14	Mean		977	25.4	38.5		1,251	19.5	64.2		658	32	20.6				
15	Ratio II/I (means)	0.4	12.2	6.5													
16	Ratio I/II (means)	2.7	0.1	0.2													
	Group I																
17	Total	172	13,788	669	20.6												
18	Mean		80.2	3.9	20.6												

Key to Column symbols: -- C - number of centres
-- P - population
-- F - number of facilities

relationship whereas between Groups III and II a 1:5 relationship is apparent. It may be said that these figures are conditioned by the decisions taken in the last section, Chapter II(c) (i) where the hierarchy is defined. This is true; but the hierarchy is defined according to considerations which pertain to the comparative characteristics of the centres as these are expressed in graphical position. If the characteristics are validly described, and if the logic of the divisions is sound, then it follows that the relationships among the parts of the hierarchy are to be considered sound too.

Columns 5 through 8 contain the data relating to Level A centres. Because it proves impossible to identify Levels A and B among first order centres, characteristics of the hierarchical relationships do not extend to this order. There are 35 second order centres at this Level, 7 third order, 9 fourth order and 3 fifth order; the ratios of these groups to each other are, respectively, 0.2, 1.3, and 0.3 (Column 5). The mean populations of these centres are 1,251, 4,438, 7,275, and 14,257; the relationships among these may be expressed in the ratios 3.6, 1.6, and 2.0 (Column 6). In Column 7 the numbers of facilities typically found in places of these orders are 19.5, 60.0, 128.0, and 298.0. These are related numerically in the respective ratios 3.1, 2.1 and 2.3. Finally, in Column 8, the population per facility ratio for Level A centres shows that in second order places there are on average, 64.2 persons per facility, 74.0 persons in third order centres and, in fourth and fifth order centres, 56.8 and 47.9 persons per facility respectively.

The population per facility ratios decline progressively with the fourth and fifth order centres, and the second order centres

also have a lower average ratio than centres of the third order. Whether the important deviation is the high ratio of the third order or the lower one at the second order is not clear; but further mention is made of this below and some insights may emerge after the Level B relationships are noted.

Level B centres are described by the data in Columns 9 through 12. There are 30 second order centres, 6 third order, 8 fourth order, and 3 fifth order; the ratios among the numbers in each order are 0.2, 1.3, and 0.4. The mean population of centres in the same order of ranking are 658, 1,865, 4,794, and 12,615. The ratios relating these data are 2.8, 2.6, and 2.6 - reasonably close to the 3.0 ratio predicted by central place theory. The mean number of facilities in second order centres is 32 and it increases with succeeding orders to 96, 187, and 366. The ratios relating these numbers are 3.0, 2.0, and 2.0. Finally, the population per facility ratio is 20.6 for second order places. It drops to 19.4 in the third order, and then rises to 25.6 and 34.5 in the fourth and fifth orders. This rise in the ratios is in contrast to the decline noted for Level A centres and points out the increasing similarity between centres as higher groups are reached in the hierarchy (Column 16). This trend is not entirely unexpected, however, as inspection of the distribution on Figure 2 reveals. A further observation about the trends notes the similarity in the rate of change revealed in Figure 3. The trend for the population per facility ratios is log $Y = 1.9516 - 0.0497X$, for Level A centres, a negative exponential relationship. The slope describing the trend for Level B centres is log $Y = 1.1096 + 0.0792X$, a positive exponential relationship. Finally, the aggregate position between these two is described by the equation log $Y = 1.5927 + 0.0032X$ indicating

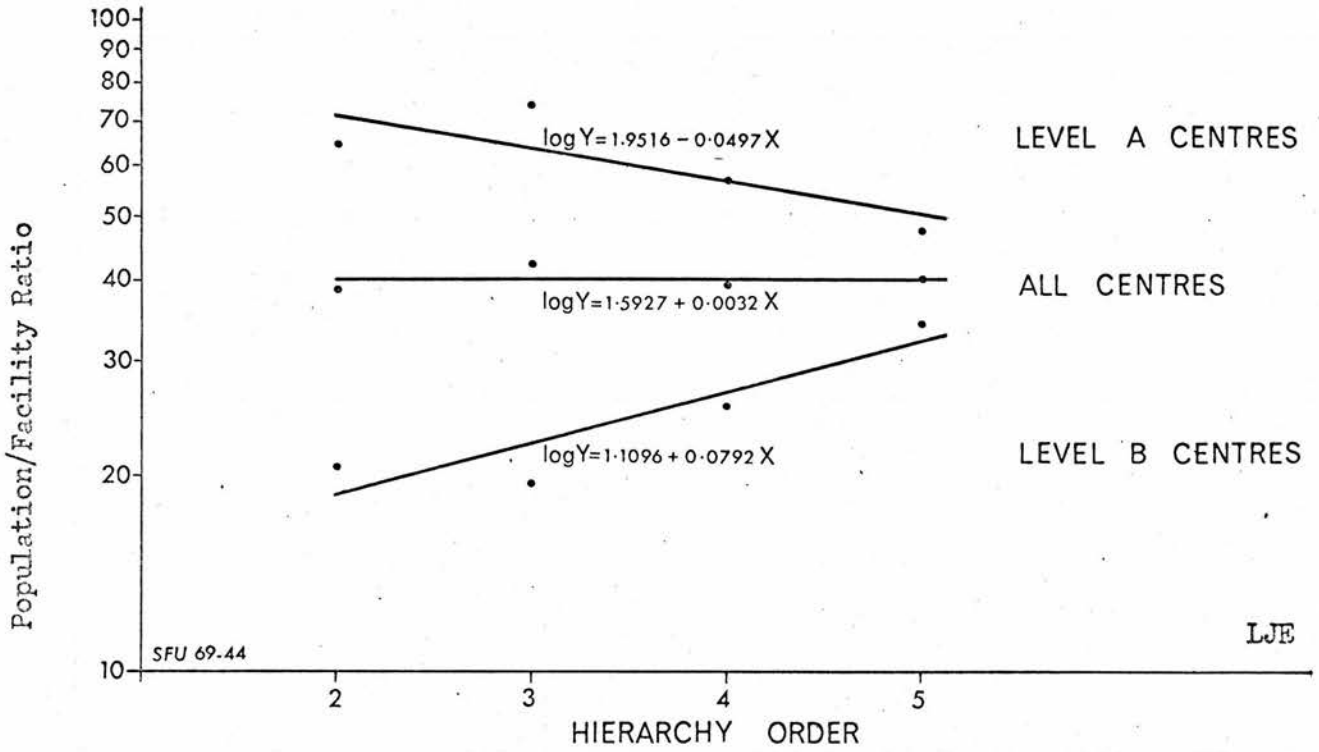


Figure 3 -- Population per Facility Ratios and Hierarchical Position

no significant slope and thus emphasizing the "mirror image" relationship of the slopes for Levels A and B centres. Although this relationship may be inferred from Figure 2 by inspection, these slope characteristics make it explicit.

Returning to the question raised at the end of the discussion of Level A centres, the first observation of Figure 3 indicates that the trends of the data for A and B level centres point to an emergent similarity of characteristics with increasing hierarchical order. The second observation is that for both A and B level trends, second and third order places deviate more from the line of regression than do fourth and fifth order places. Further, they seem to deviate at about the same rate and therefore appear to "compensate" for each other. Thus the question becomes one of the internal characteristics of the hierarchy - the trends are opposite in detail as well as in general direction and it is a question whether the second or third order centres, or both, which deviate.

In order to examine this question, third order centres are treated first because to some extent the points to be made for each order are similar; further, because there are relatively few third order places, they may be discussed in some detail. Third order centres at this Level are South Queensferry, Currie, Blackburn, Fauldhouse, Newtongrange, Easthouses, and Cockenzie and Port Seton. These centres have an average population per facility ratio of 74.0, the highest mean value for any hierarchy Group. In most cases they lie close to larger centres, and/or have witnessed large-scale housing developments, and/or exhibit a pattern of frequent movement along main roads to larger places. South Queensferry and Currie have in common

their close proximity to Edinburgh and much commuting in and out of the city. Indeed Currie now appears to be essentially a suburban appendage of the city, one "sponsored" by the Midlothian County Council. Also, Balerno, situated nearby, is an established point of service to the local area as reflected in its relatively low population/facility ratio. South Queensferry loses in a competitive sense to Linlithgow and Bo'ness to the west, both of which tap fairly extensive hinterlands along the road axes leading to Edinburgh. Similarly, to the south and west, Broxburn and Uphall curtail South Queensferry's contacts.

Blackburn is badly situated for the development of personal services because it lies within about three miles of each of Bathgate, Whitburn, and West Calder, three of the most influential centres in West Lothian. But the continued expansion of housing in Blackburn has been possible because of its comparatively favourable site and it should be noted that changes are taking place rapidly and a large shopping complex is being created, in conjunction with further housing. Fauldhouse, which also falls in this group, seems to be one of the unfortunate "have-nots" among communities of the area. It has access to Whitburn within three miles but, in contrast to Blackburn's opportunities, this provides only very limited scope. The nearest larger place to the west lies outside the study area; it is the congeries of communities known as Shotts where some higher order services may be found. However, the relatively isolated situation of Fauldhouse and field observation of the townscape, in which many of the elements may be seen to be in bad repair, suggest that this community occupies a poor relative position in terms of the amenities of personal services for its inhabitants.

Newtongrange and Easthouses are both places characterized by attempts at mass housing. In the former, row upon row of cottages were built beside the colliery; in the latter County Council housing has been developed on a large scale. Together, they contribute to what appears to be an emergent physical connection of Dalkeith and Gorebridge by an interposed mass of building. The functional positions of these two centres then are necessarily inferior if they are seen as accretions to the two strong functional centres which they separate. Finally, the burgh of Cockenzie and Port Seton is functionally closely allied to Tranent (especially through the operations of the East Lothian Co-operative Society), to Prestonpans, and especially to Musselburgh to which it is connected by good bus services. Cockenzie and Port Seton has almost no competitive strength in the countryside in the face of the East Lothian Co-operative's activities and therefore has developed no service potential for such a market. It is then a community whose main outside contacts are those of its own members going elsewhere for their own personal reasons.

Level B third order centres contrast markedly with those of Level A. At 19.4 the mean population/facility ratio is not only much lower, it is in fact the lowest of all Groups in the hierarchy. In this respect these two demonstrate the extreme polarization of centres based on this ratio, the one being almost four times the other in magnitude. If the circumstances of the Level A centres of this order are seen above as related to the very close spacing of settlement, the rush to provide housing both for an increasing population and also to upgrade the general standard of living, the circumstances of Level B centres may be looked at in somewhat similar terms although the results may differ. There are six centres in this Group, Duns,

Eyemouth, Coldstream, Melrose, Innerleithen, and West Calder. All except the last, West Calder, are Border towns and are burghs, the latter giving them some officially derived status among centres. (Of the seven Level A centres only South Queensferry and Cockenzie and Port Seton are burghs.) Inspection of the locations of these six centres reveals that they are widely spaced within the more open mesh of settlement of the Borders and generally are some distance from a comparable or higher order place. Eyemouth is some 10 miles from Berwick-on-Tweed and nearly twice that distance from Duns. Similarly, Duns is about 15 road miles from Coldstream which, in turn is separated from Kelso by about 10 miles. Melrose lies close to Galashiels but, offsetting the implications of absorption by the larger centre, the special attractions which Melrose offers as a "status" centre preserve for it to some degree a distinct and separate existence at a time when burgh pride in the Borders is a point of frequent criticism.(11) Innerleithen lies about 8 road miles from Peebles but is significantly located at a valley junction where the valley of the Leithen Water opens from the north into the Tweed Valley and the valley of the Newhall Burn opens from the south providing access to and from the Yarrow Valley. West Calder is the exception in this group in that it is part of the close settlement of West Lothian but, it has already been noted that its marginal location between the mining areas to the north and agricultural ones to the south and its distance from Edinburgh along the A 71 - the major route axis in the area - provide the opportunities for it to develop as a centre for a wide tributary area.

In addition to the distance from other centres, each Level B

place is notable for some important geographical influence which provides a distinctive impetus and which other centres in their vicinities may lack. Eyemouth is a fishing centre of considerable importance along this coast and thus a larger base of population and economy underpins this community as compared with nearby inland centres - even those on the A-1 or the main railway. In Duns, the County town, a concentration of administrative activity bolsters it. Coldstream is important as an historic crossing point of the Tweed, and Melrose, Innerleithen, and West Calder have already been briefly discussed.

Finally, in regard to activity, it may be seen in Chapter III how important these centres are in terms of their outside contacts with individuals in the countryside. The population/facility ratio implies this importance, and it is demonstrated in the number of services offered and the van trades sponsored from these places.

As a result of the examination of these centres, the basic distinction between these two Levels at the third order appears to relate closely to the density of settlement. Level A places are close to other competing and sometimes more important centres and indeed are mere adjuncts to them in some respects. The Level B third order places by contrast are frequently the important centres for a considerable tributary zone and thus are well established as organizing centres for life in the countryside.

If one may infer that Level A third order centres approach "mere adjuncts" to larger places, one might expect that second order places of this Level would be included in the statement. But the population per facility ratio is lower, implying the opposite. Further, these places exist within the same close fabric of settlement as do third order places. The apparent paradox then must be explained by

different factors. It is suggested here that the deviation of this Group is due to the quality or type of facilities available in the component places. Most of the facilities are low order, with only food retailing being ubiquitous and such facilities as drapers, confectioners, public houses, halls, primary schools, post offices, etc., being typical. (See Table 7 in the following Section.) All these facilities are those normally considered to be elemental in a small community and they are not augmented by any higher order activity such as characterize third order centres. Thus the provision of such facilities is a low order consideration and assists in understanding why the population/facility ratio is lower for second order Level A places.

The explanation offered for Level A places applies to some extent for Level B places at the second order. Centres are fairly small and chiefly oriented in activities to satisfying basic small-community desires. In all, however, more is offered than in Level A places, and this is an expression of the central place roles which these centres perform; this also ties in closely with the points made regarding Level B centres of the third order. However, the larger number of these places and their closer proximity to each other or to higher order centres tend to reduce their effectiveness as central places on a comparative basis with the dominant third order centres. Thus they may be less dependent upon outside contacts to support the relatively low level of activity and thus the population/facility ratio is higher than the same ratio in third order places.

Finally, Columns 13 through 16 in Table 3 express some relationships between Levels A and B. In Column 13 it is somewhat

surprising to note how close the ratios are to unity and therefore how comparable are the total numbers of A and B level centres at each stage in the hierarchy. In Column 14 the populations are shown to be about equal only in the fifth order places - where the centres are the most comparable according to the population/facility ratio. At the second order stage, there are just over twice as many people living in Level A centres as in Level B, and at the third order stage this becomes almost three times as many. The inference may be made that Level B third order centres depend upon external contact to maintain their high order positions. Finally, at the fourth order, Level A centres have only 1.7 times as many people as Level B places and this drop leads on to the near equality of the fifth order populations at each level. In all cases in Column 15 (Rows 1, 5, 9, 13) it is to be noted that Level A centres are less well endowed with functional facilities - 70% of the complement of Level B centres at the second and third orders, and 80% at the fourth and fifth. This serves to emphasize the inference repeatedly drawn from the population and facilities data and their interrelationships. Column 16 shows the relationship between the population/facility ratios already discussed in relation to Table 3 and they need not be elaborated here except for the reminder, in summary, that at the first level of comparison (Columns 8 and 12) Level A centres have very much higher population per facility ratios than do Level B centres; further, at a second level of comparison, (Columns 8 and 12 or 14 and 15) these figures express the discrepancies in the plotted data of Figure 3 where their similarity to each other is shown to increase with hierarchical order. In Columns 14 and 15 it is readily seen that with increasing order, unity is approached.

In addition to the reminder provided by the implication of Column 16's figures, other points which arise from inspection of Table 3 may now be summarized. First, little correspondence to the hierarchical relationships defined by Christaller is noted, although the population of Level B centres approaches it, implying that these places conform more closely to classical central place theory than do Level A centres. Second, the importance of deviations of the population per facility ratios from close exponential relationships is seen to lie in the insights which may be gained by close examination of the places which comprise the "deviant" groups. This examination highlights factors of settlement density, distinctive characteristics of places, and the order of the activities carried on. Third, the surprising similarity in the number of Level A and B centres at each stage in the hierarchy may be taken as coincidental but this even division in central places facilitates using the Level A-B distinction as an articulation point throughout the remainder of the enquiry.(12)

Although many explanations of the differences between Level A and B centres may be possible, three further suggestions, more specific than those already mentioned, are discussed below. Each would merit further research. First, the scale of facilities may differ between centres at these two levels. For example, at the time when field work was being conducted, it was noticeable that supermarkets were often part of the structure of Level A towns but not of Level B. One supermarket may serve, on average, many more customers than a small grocery shop and it may carry the stock of a variety of small shops combined. Yet it counts as only one facility. Thus scale of operations may be a factor in explaining the discrepancy and, in general

support of this suggestion, it may be noted that Fleming found that the average size of shop in Scotland varies directly as the population served.(13) Numerous references to this point are made later, especially in Section (e) of this Chapter. Second, population increases, being greater in Level A centres than in Level B, identify a condition of pressure on facilities on the one hand and diminishing use of facilities on the other. (see Figure 1 in Chapter 1) The third suggestion amplifies the second in referring to differential rates of growth. (see Figure 1 in Chapter 1) It is apparent that, in Level A centres, Councils have been actively re-housing people. In addition, Level A centres generally have been receiving more newcomers than have Level B centres. The rate of building of new housing may exceed that of the provision of facilities because of relatively low priority of the latter, lack of individual private initiative, or because the style of retailing differs from the past in that it comprises larger units and thus appears to lag. It is also possible that the statistics compiled represent stages in development where Council plans were in process of completion through phased programmes. Finally, there is no information as to the extent of van trading by firms which are not well represented in permanent shops but common observation suggests that a not insignificant trade is carried on in this manner. All these suggestions and more may be involved in the difference between Levels A and B centres.

The internal characteristics of the hierarchy are seen to require considerable explanation and further speculation in order to gain insight into the functional structure of settlement in this area. The difference between centres in terms of a simple population per facility ratio may be seen to produce complex issues and it is to

attempt further understanding of the settlement hierarchy in south-east Scotland that the following sections deal first, with the functional structure and second, specifically with the diversity of that structure.

II (c) FOOTNOTES

1. Studies dealing with hierarchical relationships among small centres include Berry, B. J. L. and W. L. Garrison, "Functional Bases of the Central Place Hierarchy," Economic Geog., XXXIV, 1958, pp. 145-154; Brush, J., "The Hierarchy of Central Places in Southwestern Wisconsin," Geog. Rev., XLIII, 1953, pp. 380-4C2; Stafford, H. A., "Functional Bases of Small Towns," Econ. Geog., XXXIX, 1963, pp. 165-175.

2. Smailes, A. E. "The Urban Hierarchy in England and Wales," Geography, XXIX, 1944, pp. 41-51. In this paper Smailes ascribes particular importance to certain key variables. For example, a Woolworth's store is taken to be an indication of "town status".

3. Number of functions is not used here because the functional classification defines the upper numerical limit of functions as 24. Therefore, in order to allow for the possibility of more than 24 functions in centres, the functional classification must be restructured to be more finely textured, or some other approach must be followed. Because the functional classification is developed inductively from the data available, the 24 Categories are deemed appropriately derived as they are the result of data analysis and not a framework into which data is forced. Therefore the number of facilities is chosen as an alternative set of data for comparison with population.

4. Olsson, Gunnar Distance and Human Interaction: A Review and Bibliography, Bibliography Series, Number 2, Reg. Sci. Res. Inst., Philadelphia, 1965. See pp. 18-21. More recently in 1966, three authors have commented upon this point. Raymond Murphy leaves the question open in his discussion of "The Urban Hierarchy". (See pp. 95-96 in The American City: An Urban Geography, McGraw-Hill, New York, 1966.) H. G. Barnum notes that the hierarchy he derives in part of southern Germany adds evidence from another part of the world to the growing list of studies in various areas where hierarchies have been demonstrated. (Market Centers and Hinterlands in Baden - Württemberg, University of Chicago, Department of Geography, Res. Ser. No. 103, 1966, 173 pp. + xix. See pp. 118.) M. Dacey, after examining the theoretical distributions of population clusters within a central place system, concludes that Beckmann's 1958 resolution of the rank-size distribution versus the stepped hierarchy controversy is not final because the concept of what populations to include was at variance with Christaller's theoretical formulations. Dacey's own re-examination, made consistent with Christaller, demonstrates that the two views are still incompatible although he is unwilling to assert that either approach must be abandoned. (See Dacey, M., "Population of Places in a Central Place Hierarchy," Journal of Regional Sciences, VI, No. 2, 1966, pp. 27-33.

5. This statement stems from the initial point of Berry and Garrison's "Functional Bases..." paper, op.cit.; they set out to explore, by empirical test, the solution to the "Brush-Vining controversy" in which Vining refutes Brush's demonstration and use of an hierarchy based upon functional characteristics. (Brush, J., op.cit., and Vining, R., "A Description of Certain Spatial Aspects of an Economic

System," Econ. Dev. and Cult. Change, III, 1955, pp. 147-195.) Berry and Garrison claim general validity for their findings in support of the existence of a stepped hierarchy, but, in 1962 Berry noted how it is possible to observe both a continuous distribution and a stepped one from the same set of data. (Berry, B.J.L. and H.M. Mayer, Comparative Studies of Central Place Systems, Final Report, Office of Naval Research, 2121-18, Project NR 389-126, 1962. See Part I.)

6. Olsson, op.cit., pp.20.

7. Philbrick, A.K., "Principles of Areal Functional Organization in Regional Human Geography," Econ. Geog., XXXIII, 1957, pp. 299-336.

8. Midlothian County Council, County Development Plan, Survey Report, 1956. See pp. 188.

9. Berry and Garrison conclude their 1958 study, op. cit., by noting four centres which are exceptions to the general trend of the population/activities relationships. The authors suggest that the reasons for their high ratios are: 1) population growth which has outstripped the growth of "service industries" and, 2) the general absence of a surrounding population which is dependent upon them for services. Both reasons are tied up with the dormitory functions of these centres which lie within easy commuting range of Seattle. In 1960 Berry specifically tackled the problem of the relationship between the urban hierarchy and "expanding metropolitan communities". ("The Impact of Expanding Metropolitan Communities upon the Central Place Hierarchy," Annals, Amer. Assoc. Geogrs., L, 1960, pp. 112-116.) He concludes that the differences between centres within and beyond the commuting range of a major centre are not properly seen as effects of metropolitan dominance. Rather, specialization of function in the metropolitan community should be seen as a part of a larger process of hierarchical development which includes the metropolis; centralization is at work throughout the hierarchy; and population is not a complete "index of centrality" except in the special case where the urban centre exists by and for its central place functions.

   The division of centres into A and B Levels in this study is based on the differences between the population/facility ratios. However, with the mining and industrial history of the Lothians, it would be too simplistic to attribute the differences in ratios either to metropolitan proximity or to a generally expanding hierarchy. Regardless of causes, however, it is still necessary to recognize the distinctions among places on this functional basis.

10. These two centres are taken as examples because they are the extreme opposites in the range of population/facility ratios for fifth order centres. Dalkeith has a ratio of 31.8; Galashiels, 33.9; Hawick, 36.7; Bathgate, 42.5; Musselburgh, 46.0; and Bo'ness, 59.9.

11. The apparent pride of place attached to Border burghs is thought to be of some detrimental significance to future Borders economic development. This opinion is sufficiently current to find official expression. (See pp. 94 in The Scottish Economy, 1965 to 1970, A Plan for Expansion, Edinburgh, HMSO, Cmnd. 2864, January, 1966.) Contrary opinions are to be encountered, however, as illustrated by the following extracts from

a letter to The Scotsman, dated April 16, 1966, from a Mr. Andrew Haddon, of Hawick.

> "...I know that there are few parts of the United Kingdom where local patriotism is so strong as it is in the Borders. To my mind these local loyalties are a good and healthy thing...
>
> "...we who live in the Borders find that this sense of community has gone from many other parts of the country and we think that our fellow-countrymen are poorer by the loss of it.
>
> "Unfortunately, in dealing with the Civil Servants and politicians who have the power to mould our future, we find that for the most part we are dealing with rootless individuals who not only do not share our sense of the importance of the local community but who are positively bent on destroying it.
>
> "...Hence the statement in the White Paper that the local separateness and rivalry of the Border burghs 'now constitutes one of the region's serious handicaps'. This statement is made as if it were a self-evident truth which needs no supporting evidence ... But without such support all that it means to the Borders is that the writers of the 'study' had not even begun to understand what they were studying..."

12. This "even division" between Levels A and B is dependent also on the nature and extent of the study area. As is demonstrated in Chapter III, however, landward contacts with centres are remarkably self-contained within the study area, sometimes described as the "Edinburgh region" or "south-east Scotland". This allows the claim that the Level A - B balance does not provide a distorted view of the functional settlement structure.

It may be noted in passing that for the 1951 meeting of the British Association for the Advancement of Science, held in Edinburgh, the Scientific Survey of South-eastern Scotland was published. In this volume the various authors took south-eastern Scotland to include Fife and Kinross, a definition employed in Professor Ogilvie's opening paper, "South-eastern Scotland: The Region and its Parts".

13. Fleming, J.B., "An Analysis of Shops and Service Trades in Scottish Towns," Scot. Geogr. Mag., LXX, No. 3, 1954. One of Fleming's general findings for Scotland is that the smaller the population served, the smaller is the average size of shop.

(d) The Functional Structure of Centres

(i) The Context

In Section II(c) both definition and analysis of the hierarchy are predicated upon the relationships exhibited graphically between population in centres and the number of functional facilities. Dealing with facilities in a purely numerical way carries the advantages that there is no upper limit to the numbers to be considered and that a very clear distinction emerges between basic types of centres (Levels A and B). It is obvious, however, that the numerical approach is insufficient in itself to characterize an hierarchy or even to define it, as the discussion relating to the division into hierarchy Groups indicates. Just as it was necessary to supplement the numerical facilities data by reference to functional characteristics in order to clarify the hierarchical divisions, so it is necessary to explore the functional structure of hierarchy Groups and Levels in order to portray the functional nature of settlement in the area.

The wide variation of functions makes their classification a high priority. The classification, discussed in Section II(b), provides a framework for organizing all the diverse functions carried on in centres to serve the population of the area. Thus the functions identified for each centre are distributed under the various Categories of the classification, allowing characterization of centres by Category. The aim of this approach is to demonstrate the functional structure of centres within a uniform framework. In discussing aggregates of centres, however, the classification itself often becomes the focus (although not the object) of analysis because it is the framework within which centres relate to each other functionally.

Patterns exhibited in the classification therefore represent collective functional structures of more than one centre. The terminology of analysis reflects this inversion of approach where it is adopted, particularly in Section II(d)(iv), and functional categories may be described as more or less important for the group of centres represented in them.

Appendix E lists, by Category, the specific details of the functional structure of centres. It is impractical to discuss the whole set of data, however, because of its bulk; therefore the discussion which follows relates to the information in Table 4 where summaries of data entries for each Group and Level are set down by Categories of functions.

Table 4, divided by Groups and Levels of centres, has four Rows relating to each division. These Rows represent total occurrences of facilities in functional Categories for each grade of centres, followed by the mean occurrences per centre in each Category. The number of centres represented in each Category is listed along with the percentage of centres so represented.

In II A centres the total number of facilities of all kinds is 683, considerably fewer than the 967 found in II B places. As there are five more centres in II A than in II B the difference is accentuated in the mean occurrences per centre, 19.5 for II A places and 32.2 for II B. II A centres have, however, many more facilities than do III A centres (683 to 420) but the mean occurrence per centre is only one-third as great (19.5 to 60.0). III A places fall short of both the total and mean values of IV A centres (420 to 1151 in Row 1 and 60.0 to 127.9 in Row 2). And IV A centres, three times more numerous than V A places, have 1151 facilities as against 893. However, the mean number

TABLE 4

FUNCTIONAL CHARACTERISTICS OF AGGREGATES OF CENTRES

CENTRES HIERARCHY GROUP	LEVEL	ROWS	Categories in Functional Classification 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	TOTAL
II	A	1	157	21	25	3	5	0	13	0	4	1	1	11	2	59	30	37	74	50	41	8	68	61	12	0	683
		2	4.5	0.6	0.7	0.1	0.1	0	0.4	0	0.1	0.03	0.03	0.3	0.6	1.7	0.9	1.1	2.1	1.4	1.2	0.2	1.9	1.7	0.3	0	19.5
(N=35)		3	35	18	20	3	5	0	12	0	3	1	1	9	2	32	17	20	31	26	21	6	31	33	10	0	
		4	100	54.3	62.8	8.6	14.3	0	34.3	0	8.6	2.9	2.9	25.7	5.7	88.6	48.6	57.2	88.6	74.4	60.0	17.1	88.6	94.4	28.6	0	
	B	1	181	24	28	6	14	2	12	4	2	5	2	14	1	76	20	117	90	78	83	23	76	70	39	0	967
		2	6.0	0.8	0.9	0.2	0.5	0.1	0.4	0.1	0.1	0.2	0.1	0.5	0	2.5	0.6	3.9	3.0	2.6	2.8	0.8	2.5	2.3	1.3	0	32.2
(N=30)		3	30	18	17	6	11	2	11	3	2	5	1	11	1	30	10	30	30	30	27	12	30	30	27	0	
		4	100	60.0	56.7	20.0	36.7	6.7	36.7	10.0	6.7	16.7	3.3	36.7	3.3	100	33.3	100	100	100	90.0	40.0	100	100	90.0	0	
III	A	1	83	15	18	6	11	2	11	1	4	0	3	5	0	39	22	21	36	28	47	8	33	23	4	0	420
		2	11.9	2.1	2.6	0.9	1.6	0.3	1.6	0.1	0.6	0	0.4	0.7	0	5.6	3.1	3.0	5.1	4.0	6.7	1.1	4.7	3.3	0.6	0	60.0
(N=7)		3	7	6	7	4	5	1	7	1	4	0	2	4	0	7	7	7	7	7	7	3	7	7	4	0	
		4	100	85.7	100	57.1	71.4	14.3	100	14.3	57.1	0	28.6	57.1	0	100	100	100	100	100	100	42.9	100	100	57.1	0	
	B	1	90	17	25	9	15	4	12	2	4	4	2	6	2	41	19	54	62	34	45	30	35	34	26	2	574
		2	15.0	2.8	4.2	1.5	2.5	0.7	2.0	0.3	0.7	0.7	0.3	2.0	0.3	6.8	3.2	9.0	10.3	5.7	7.5	5.0	5.8	5.7	4.3	0.3	95.7
(N=6)		3	6	6	6	6	6	3	6	2	4	3	1	4	2	6	6	6	6	6	6	5	6	6	6	2	
		4	100	100	100	100	100	50.0	100	33.3	66.7	50.0	16.7	66.7	33.3	100	100	100	100	100	100	83.3	100	100	100	33.3	
IV	A	1	234	42	58	18	28	5	21	4	15	4	4	20	10	77	63	98	112	75	93	31	61	52	25	1	1151
		2	26.0	4.7	6.4	2.0	3.1	0.6	2.3	0.4	1.7	0.4	0.4	2.2	1.1	8.6	7.0	10.8	12.3	8.3	10.3	3.4	6.9	5.9	2.9	0.1	127.9
(N=9)		3	9	9	9	8	9	3	9	4	9	4	4	9	8	9	9	9	9	9	9	7	9	9	9	1	
		4	100	100	100	88.9	100	33.3	100	44.5	100	44.5	44.5	100	88.9	100	100	100	100	100	100	77.8	100	100	100	11.1	
	B	1	223	54	107	27	37	16	22	9	17	39	3	13	9	130	71	146	103	78	126	91	63	68	52	6	1510
		2	27.9	6.8	13.3	3.3	4.6	2.0	2.6	1.3	2.1	4.9	0.4	1.6	1.1	16.3	8.9	18.3	12.9	9.8	15.8	11.4	7.9	8.5	6.5	0.8	188.9
(N=8)		3	8	8	8	8	8	7	8	6	7	8	3	6	5	8	8	8	8	8	8	8	8	8	8	6	
		4	100	100	100	100	100	87.5	100	75.0	87.5	100	37.5	75.0	62.5	100	100	100	100	100	100	100	100	100	100	75.0	
V	A	1	155	17	48	10	18	1	14	6	13	9	6	5	7	76	48	67	87	48	99	35	46	29	44	5	893
		2	51.7	5.7	16.0	3.3	6.0	0.3	4.7	2.0	4.3	3.0	2.0	1.7	2.3	25.3	16.0	22.3	29.0	16.0	33.0	11.7	15.3	9.7	14.7	1.7	297.7
(N=3)		3	3	3	3	3	3	1	3	3	3	2	3	1	3	3	3	3	3	3	3	3	3	3	3	3	
		4	100	100	100	100	100	33.3	100	100	100	66.7	100	33.3	100	100	100	100	100	100	100	100	100	100	100	100	
	B	1	186	31	56	12	24	9	19	4	23	7	7	10	4	80	55	116	85	56	94	59	50	35	68	7	1097
		2	62.0	10.3	18.6	4.0	8.0	3.0	6.3	1.3	7.7	2.3	2.3	3.3	1.3	26.7	18.3	38.7	28.7	18.7	31.3	19.7	16.7	11.7	22.7	2.3	365.7
(N=3)		3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
		4	100	100	100	100	100	66.7	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	

Key to Rows: 1 -- Total Occurrences of Facilities
2 -- Mean Occurrences of Facilities per Centre
3 -- Number of Centres Represented in Category
4 -- Percentage of Centres Represented in Category

for V A places far exceeds that for IV A centres, 297.7 to 127.9.

In B Level centres the relationships among the Groups are about comparable with those of the A Level but the magnitudes are always greater. Thus II B centres have 967 facilities altogether with a mean of 32.2 whereas III B places have 574 facilities and a mean of 95.7. In each case the mean exceeds the comparable figure for A Level centres by about 50 per cent. III B places fall far short of IV B centres in total facilities, 574 to 1510, and the latter have about twice the mean number of occurrences, 188.9 to 95.7. Finally, IV B centres exceed V B places in total facilities, 1510 to 1097 but, as with Level A centres, the reverse is true with the mean number of facilities, 365.7 to 188.9. The mean occurrences per IV B centre exceed those of IV A places by about 48 per cent whereas V B centres exceed V A places by some 23 per cent for the same relationship.

These details of total and mean numbers of facilities in the various hierarchy Groups and Levels are sketched here as background for the discussion which follows. Except for first order places, the functional structure of these aggregates of centres is discussed within the framework of the classification. Within each Category the numbers refer to facilities. Because the study area is spatially defined at the outset, the total occurrences of facilities (Row 1) and the number of centres represented in each Category (Row 3) are not in themselves significant figures beyond describing total magnitudes and for their use in deriving the more important mean occurrences per centre and percentage of centres in each Category (Rows 2 and 4 respectively). The main focus is on the distribution of facilities among the various Categories.

The first part of the following section is devoted specifically to a discussion of first order places, after which the main part deals with the rest of the hierarchy.

(ii) Identification of "trait complexes"

The major portion of the analysis of centres depends upon the classification of functions. However, first order centres are so small that, in almost all cases, to assign their few facilities to Categories would be to generalize their functional structure unnecessarily. Therefore first order centres are discussed with reference to the specific functional facilities recorded for each place. The remainder of the hierarchy is then explored with reference to the functional structure of centres as described by the Categories of the functional classification.

First Order Centres

Appendix E lists the 172 first order centres alphabetically and indicates the functional structure of each place according to the number of facilities. The aggregate functional characteristics of first order places, however, is more readily shown in Table 5.

It may be noted that by far the highest number of occurrences of facilities, on both absolute and percentage bases, is in Columns 1 through 6. These Columns represent community or village halls, general shops, post offices, kirks, and primary schools. The next most significant item, numerically speaking, is the garage or filling station but the percentage of all centres so supplied drops to 31.4 in this case. Therefore garages, as facilities of first order centres, are not typical and must be considered of secondary importance. Similarly, all other facilities are less important than the five listed above; these are now identified as the essential trait complex of first order centres.

Along with garages, inns and/or public houses and joiners may

TABLE 5

AGGREGATE FUNCTIONAL CHARACTERISTICS OF FIRST ORDER CENTRES

Functions	Hall	General shop	P.O./Gen. shop	Post offices	Kirk	School	Garage	Inn/pub.	Joiner	Police	Medical Serv.	Coal/coke	Misc.	Draper	Bank	Baker	Cafe	Insurance ag.	Contractor	Hardware	Total
Column	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Total	135	66	40	56	95	89	54	39	39	13	9	8	7	5	4	4	2	2	1	1	669
Percentage of Centres with Facility	77.8	38.4	23.2	32.6	55.2	51.7	31.4	22.7	22.7	7.6	5.2	4.7	4.0	2.9	2.3	2.3	1.2	1.2	1.0	1.0	

Total Number of Centres: 172

Notes: 1) The functional characteristics of first order centres are detailed, by individual centre, in Appendix .

2) Post offices and general stores occur both independently and in association. In order to find the total number of post office outlets, Columns 3 and 4 must be summed. Thus there are 96 post offices in first order centres. Similarly, Columns 2 and 3 must be added to get the total number of general shops. They number 106. Now the percentage of places having these facilities may be calculated and they are, respectively, 55.8 and 61.6.

be taken as secondary features of the functional structure of this Group of centres. The latter two both occur 39 times for a percentage appearance of 22.7. A steep decline to 13 occurrences or 7.6% is seen between joiners and police, and the latter may therefore be included with a third, least important set of functions.

An attempt to portray the trait complex structure is made in Figure 4. The essential trait complex, or core facilities are shown within the inner square as associated members of a unit. Surrounding this core in concentric fashion are secondary facilities, and then the remainder which, because they are so sparsely distributed among first order centres, may not be inferred as typical but rather as exceptional.

All the members of the trait complex may be described as essentially local in nature. The halls are almost invariably the "village halls" maintained, in part at least, by grants from District Councils, and used for various activities of a local character, some of which are more regular and better organized than others. For example, local branches of the Scottish Women's Rural Institute very commonly meet in halls. This group is probably the main one controlling the continued upkeep and use of halls, not only because of their regular meetings during the year but also because they often take the responsibility for regular cleaning. In some places the hall is actually known as the S.W.R.I. hall (e.g. Damhead) and in one case, Old Cambus, it was pointed out that the Institute had raised the money to build its own building.(1) Other activities vary but include Sunday Schools, fortnightly or monthly church services, men's evenings, and games evenings for young people. In many areas activity has declined greatly in recent years. The causes of decline are generally thought by local residents

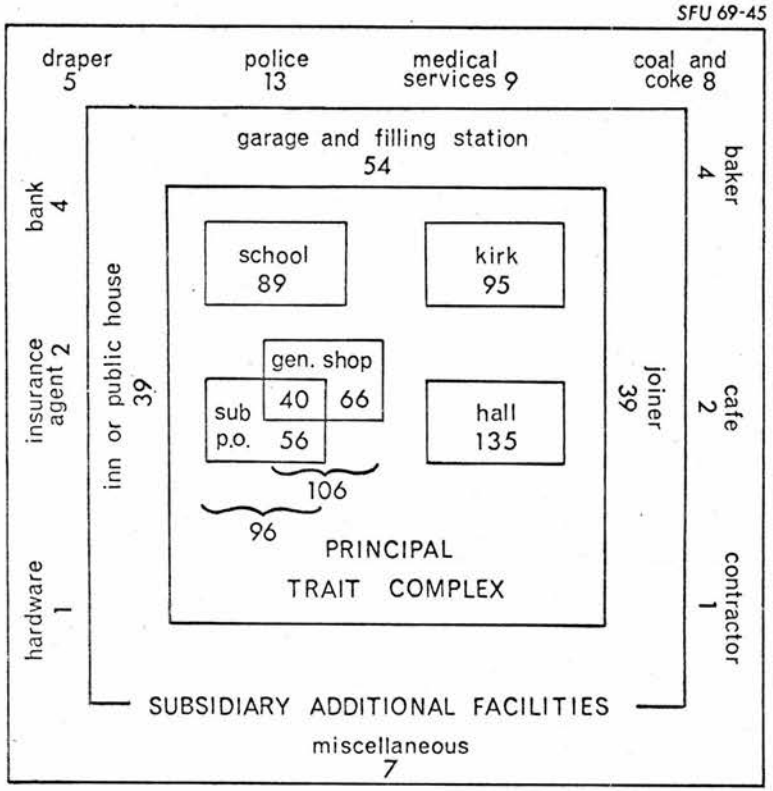


Figure 4 -- Aggregate Associations of Functions: First Order Centres. Numbers refer to the frequency of occurrence of facilities in all first order centres.

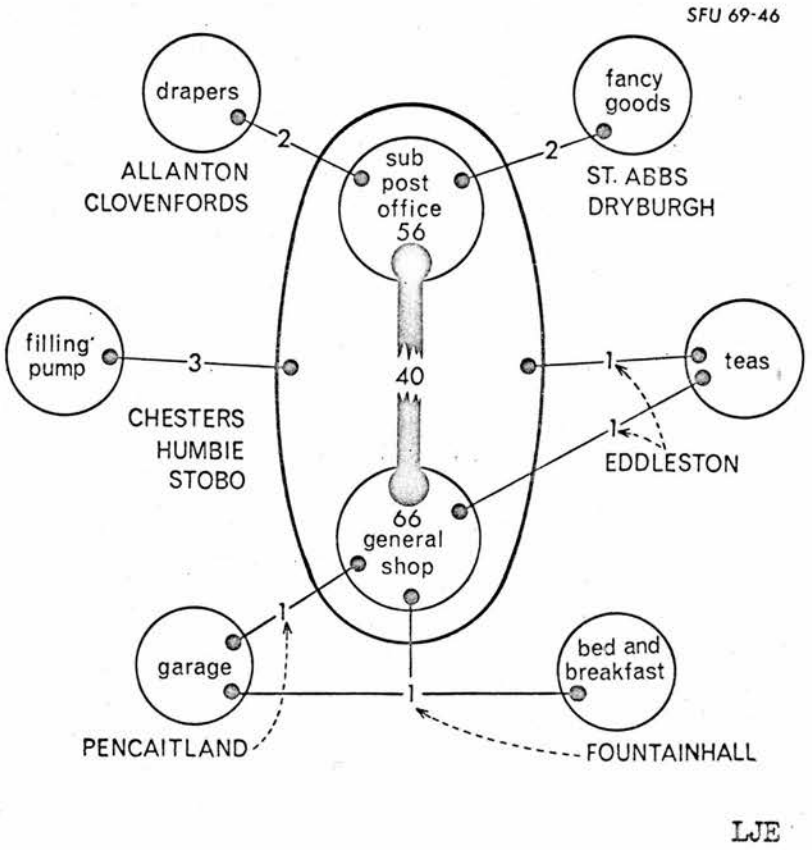


Figure 5 -- Combinations and Frequencies of Sub-Post Offices and General Shops with Each Other and with Other Functions in First Order Centres

to be due to the loss of population, especially of the younger people, but one wonders if the advent of and devotion to television have not provided an equally important cause.

Sub-post offices and general shops are operated by the same individual in the same premises in 40 instances. There are 66 general shops and 56 sub-post offices as independent units in addition. (See Figure 5.) In a few cases other functions are associated with the general shop, the sub-post office or with their combination, and these cases are shown with the additional functions and the centres where they occur. While these extra functions are not important numerically, it is interesting to note that Dryburgh, the site of a ruined abbey, and St. Abbs, a seacoast village, have functional reflections of tourism along with the purely postal functions which the premises also house. Similarly Eddleston, with two tea shops attached to general shops, one of which also is the post office, betrays its location on a much travelled "Sunday drive" route between Edinburgh and the Peeblesshire countryside to the south. Drapers and outfitters at Clovenfords and Allanton suggest the survival of higher order activity in a situation of general decline; certainly both villages are among the larger first order places. In Fountainhall, one family runs the general shop and garage, and also takes in people for overnight accommodation.(2) At Chesters, Humbie, and Stobo, a single petrol pump outside the combined general shop and sub-post office serves mainly local customers. With the exception of teas, bed and breakfast, and fancy goods, the extra functions are all seen as local in orientation.

Both the school and the kirk are formally institutional in the local community in contrast to the other functions mentioned. Historically they share a great deal inasmuch as the church has

traditionally been concerned with education. Schools are found in 51.7% of first order centres and kirks in 55.2%. In both a certain amount of "economic" rationalization of their numbers and distribution has occurred although in recent years this trend is more notable for schools than for kirks. In a situation where the population is both ageing and declining, the closure of schools is to be observed almost every year - at least in the Border counties. Further, rationalization by school amalgamation accelerates the process. No legal obligation of attendance affects the organization of the local kirk community. In general, the assumption by kirk officials is that the parish units define the kirk community in space but factors such as forgetting to "lift one's liens" after moving residence suggest that much variability must be acknowledged for this assumption.(3) It is also complicating to note that the Civil Parishes may or may not be coincident in space with the current kirk parishes and, as there is no centralized record of the extent of the latter, it is impossible to know exactly how much the present centre with a kirk is a development of a "parish community" historically. In the study area there are 141 Civil Parishes, and 172 first order places have been identified; schools occur 89 times and kirks 95 times. Therefore it is possible to say notionally that first order centres of the hierarchy, as recognized in this study, are to some degree descendants of parish communities of the past. If schools and kirks were among the more important ingredients of those past communities, then their typical existence in the present centres is to be expected. That they are not more numerous is attributable to amalgamations of school districts and the linking of parishes as measures of practical expediency.

The first order trait complex then is a contemporary functional unit comprising a mixture of activities and facilities representing basic obligations of the community and of society within and to itself. They have historical importance and consistency, and practical daily duties. They appear to be the activities most necessary to the continued development of society, dealing as they do with the social, economic, educational, and supernatural concerns of men.

Secondary functions of first order centres may be both local or non-local in spatial orientation. Garages and filling pumps occur 54 times for a percentage total of 31.4. Sometimes the local component of trade is obvious, such as where one pump stands in front of the post office (see Figure 5) or where it may be the successor to a blacksmith shop or an agricultural engineer. Both these latter appear to be overstated impressions. Although commonly expressed to be true, only at Hallyne and Stobo is the blacksmith shop known to be associated with the filling pump, and only at Stenton is a garage known to be the successor to an agricultural engineer. The fact that approximately one-third of all centres have some rudimentary facility for servicing automobiles, however, does suggest that this is an important function and may well be one which will increase in future. Already first order places along main trunk roads are notably catering to passing traffic (for example, Grantshouse and Burnmouth both have automobile services heavily dependent on "passing trade") and perhaps new centres may be predicted according to the patterns of location being worked out by traffic service facilities. During the course of field work, new filling and service stations opened at Orange Lane north of Coldstream at the junction of the A699 and the much travelled A697; Newtonloan

near Gorebridge would appear to receive its main impetus as a centre from the establishment there of four garages.

Inns and/or public houses and joiners both number 39 for percentage occurrences of 22.7. Like garages, both depend upon travel, the former in the case of passing trade, the latter by taking distant jobs. (See Footnote 4, Section II(a)) Neither of these functions would appear to have the viability within a small community that automobile servicing may have except where "country pubs" become centres of attraction for those willing to travel from larger centres. The examples at Howgate, Blyth Bridge, Eddleston, Mountbenger and other places suggest that "country pubs" very quickly become extensions of city and metropolitan life providing special kinds of atmosphere, food, and entertainment.

Finally, fewer than 10% of first order centres contain the residual group of activities noted. In the case of police, the location of a station and constable's house is not so much an expression of local community needs as it is the carrying out of a scheme for the distribution of police services. (4) Medical services include both District Nurses and doctors but the latter may simply reside in the centre and work elsewhere. (5) District Nurses are often married women who live where they do, not so much because of their nursing, but because of their husbands' occupations in the area and/or of the availability of accommodation. (6) All the banks noted are simply sub-branches of the branches in nearby towns, and the bakers represent survivals of local businesses providing freshly baked goods conveniently to the local area (Innerwick, Whitsome). Some are essentially part of the activity of larger centres but happen, for reasons of estab-

lished infrastructure, to be located in small places. For example, Douglas Bakeries of Galashiels bought out the local bakery in Gavinton sometime between 1960 and 1963 and uses the facilities for transferring goods to local selling vans as well as for retailing. All baking, however, is done in Galashiels. The remaining facilities noted as occurring in first order places could be discussed in essentially the same terms as those already mentioned, so it is only necessary to note that these more unusually-occurring functions may be explained mainly as historical lags where residuals are found, as expressions of outside organizations which bring a function to a centre, and in terms of stray factors of residence which give to a centre an unexpected functional attribute whose locational significance is simply the desire on the part of the person involved to operate from such a base.

Centres Above First Order

Without exception in the various Groups and Levels of centres, Category 1 (Food) is dominant numerically. Such conformity ends here, however, as functional structures vary considerably among centres. The complexity of this variation is illustrated in Figure 6 where Categories are ranked for each group in order of the magnitude of the mean occurrence of facilities (from Row 2 in Table 4). Further, the change in rank between Groups is shown by the lines linking the Category positions. This aspect of the ranking pattern is discussed in greater detail later in this Section.

Table 6 lists the functional categories in order of importance according to the mean occurrences of functional facilities per centre. While this Table indicates qualitatively which Categories are more or less prominent, Figure 6 shows the same data ranked graphically to

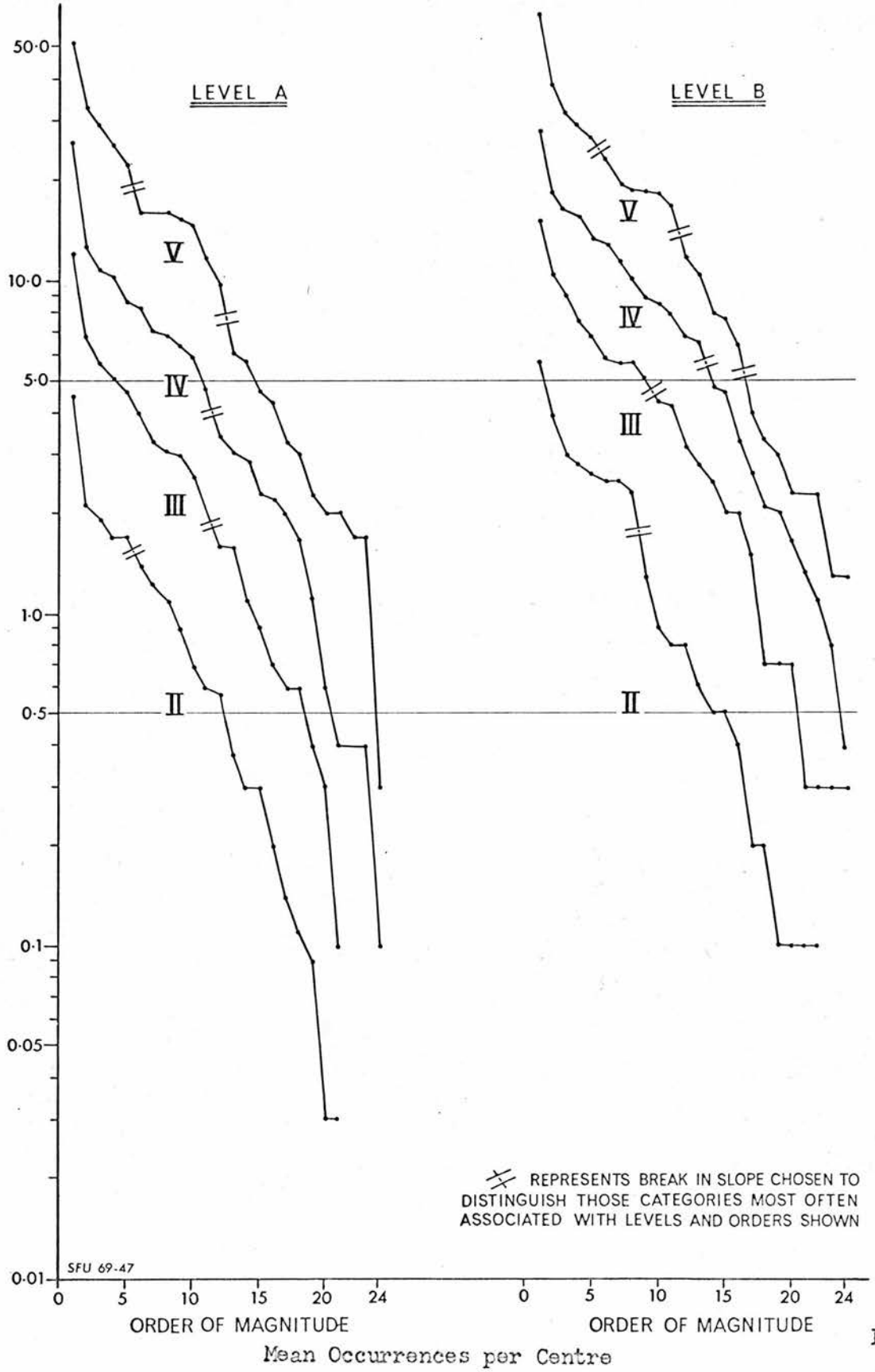


Figure 6 -- Facilities in Functional Centres Ranked by Mean Occurrences per Centre

TABLE 6

FUNCTIONAL CATEGORIES IN ORDER OF

MEAN OCCURRENCES PER CENTRE

II A Centres

Rank		
1	1.	Food
2	17.	Public assembly halls; entertainment centres
3	21.	Educational and religious institutions
4	14.	Restaurants, cafes, hotels, public houses and roadhouses
5	22.	Offices of local government, public administration, and law enforcement
(a)		
6	18.	Motor trade establishments
7	19.	Medical health and social services
8	16.	Building trades and materials; household and property maintenance
9	15.	Personal services
10	3.	Apparel and drapery
11	2.	Confectioners, tobacconists and newsagents
12	13.	Other retail
13	7.	Chemists and photographic goods
14	12.	Household fuel merchants
15	23.	Financial institutions and services
16	20.	Professional services other than medical
17	5.	Electrical goods, household appliances
18	9.	Furniture and music
19	4.	Hardware
20	10.	Jewellers, leather, sports and fancy goods
21	11.	Department and variety stores
(b)		
22	6.	Booksellers and stationers
23	8.	Cycles and cycle accessories
24	24.	News services

(a) Delimitation of trait complex.

(b) Line divides those functions which are found in II A centres from those which do not occur.

Table 6 continued -

III A centres

Rank		
1	1.	Food
2	19.	Medical, health and social services
3	14.	Restaurants, cafes, hotels, public houses, and road-houses
4	17.	Public assembly halls; entertainment centres
5	21.	Educational and religious institutions
6	18.	Motor trade establishments
7	22.	Offices of local government, public administration, and law enforcement
8	15.	Personal services
9	16.	Building trades and materials; household and property maintenance
10	3.	Apparel and drapery
11	2.	Confectioners, tobacconists and newsagents
(a)		
12	5.	Electrical goods, household appliances
13	7.	Chemists and photographic goods
14	20.	Professional services other than medical
15	4.	Hardware
16	12.	Household fuel merchants
17	9.	Furniture and music
18	23.	Financial institutions and services
19	11.	Department and variety stores
20	6.	Booksellers and stationers
21	8.	Cycles and cycle accessories
(b)		
22	10.	Jewellers, leather, and sports and fancy goods
23	13.	Other retail
24	24.	News services

(a) Delimitation of trait complex.

(b) Division between functions which occur in III A centres and those which do not.

Table 6 continued -

IV A centres

Rank		
1	1.	Food
2	17.	Public assembly halls; entertainment centres
3	16.	Building trades and materials; household and property maintenance
4	19.	Medical, health, and social services
5	14.	Restaurants, cafes, hotels, public houses and road-houses
6	18.	Motor trade establishments
7	15.	Personal services
8	21.	Educational and religious institutions
9	3.	Apparel and drapery
10	22.	Offices of local government, public administration, and law enforcement
11	2.	Confectioners, tobacconists, newsagents
(a)		
12	20.	Professional services other than medical
13	5.	Electrical goods, household appliances
14	23.	Financial institutions and services
15	7.	Chemists and photographic goods
16	12.	Household fuel merchants
17	4.	Hardware
18	9.	Furniture and music
19	13.	Other retail
20	6.	Booksellers and stationers
21	8.	Cycles and cycle accessories
22	10.	Jewellers, leather, sports and fancy goods
23	11.	Department and variety stores
24	24.	News services

(a) Delimitation of trait complex.

Table 6 continued -

V A centres

Rank		
1	1.	Food
2	19.	Medical, health, and social services
3	17.	Public assembly halls; entertainment centres
4	14.	Restaurants, cafes, hotels, public houses and road-houses
5	16.	Building trades and materials, household and property maintenance
(c)		
6	3.	Apparel and drapery
7	15.	Personal services
8	18.	Motor trade establishments
9	21.	Educational and religious institutions
10	23.	Financial institutions and services
11	20.	Professional services other than medical
12	22.	Offices of local government, public administration, and law enforcement
(a)		
13	5.	Electrical goods, household appliances
14	2.	Confectioners, tobacconists, mewsagents
15	7.	Chemists and photographic goods
16	9.	Furniture and music
17	4.	Hardware
18	10.	Jewellers, leather, sports and fancy goods
19	13.	Other retail
20	8.	Cycles and cycle accessories
21	11.	Department and variety stores
22	12.	Household fuel merchants
23	24.	News services
24	6.	Booksellers and stationers

(a) Delimitation of trait complex.

(c) Delimitation of inner trait complex.

Table 6 continued

II B centres

Rank		
1	1.	Food
2	16.	Building trades and materials; household and property maintenance
3	17.	Public assembly halls; entertainment centres
4	19.	Medical, health, and social services
5	18.	Motor trade establishments
6	14.	Restaurants, cafes, hotels, public houses and road-houses
7	21.	Educational and religious institutions
8	22.	Offices of local government, public administration and law enforcement
(a)		
9	23.	Financial institutions and services
10	3.	Apparel and drapery
11	2.	Confectioners, tobacconists and newsagents
12	20.	Professional services other than medical
13	15.	Personal services
14	5.	Electrical goods, household appliances
15	12.	Household fuel merchants
16	7.	Chemists and photographic goods
17	4.	Hardware
18	10.	Jewellers, leather, sports and fancy goods
19	6.	Booksellers and stationers
20	8.	Cycles and cycle accessories
21	9.	Furniture and music
22	11.	Department and variety stores
(b)		
23	13.	Other retail
24	24.	News services

(a) Delimitation of trait complex.

(b) Division between functions which occur in II B centres and those which do not.

Table 6 continued

III B centres

Rank		
1	1.	Food
2	17.	Public assembly halls; entertainment centres
3	16.	Building trades and materials; household and property maintenance
4	19.	Medical, health and social services
5	14.	Restaurants, cafes, hotels, public houses and road-houses
6	21.	Educational and religious institutions
7	18.	Motor trade establishments
8	22.	Offices of local government, public administration, and law enforcement
9	20.	Professional services other than medical
(a)		
10	23.	Financial institutions and services
11	3.	Apparel and drapery
12	15.	Personal services
13	2.	Confectioners, tobacconists, newsagents
14	5.	Electrical goods, household appliances
15	7.	Chemists and photographic goods
16	12.	Household fuel merchants
17	4.	Hardware
18	6.	Booksellers and stationers
19	9.	Furniture and music
20	10.	Jewellers, leather, sports and fancy goods
21	8.	Cycles and cycle accessories
22	11.	Department and variety stores
23	13.	Other retail
24	24.	News services

(a) Delimitation of trait complex

Table 6 continued -

IV B centres

Rank		
1	1.	Food
2	16.	Building trades and materials; household and property maintenance
3	14.	Restaurants, cafes, hotels, public houses and road-houses
4	19.	Medical, health, and social services
5	3.	Apparel and drapery
6	17.	Public assembly halls; entertainment centres
7	20.	Professional services other than medical
8	18.	Motor trade establishments
9	15.	Personal services
10	22.	Offices of local government, public administration, and law enforcement
11	21.	Educational and religious institutions
12	2.	Confectioners, tobacconists, and newsagents
13	23.	Financial institutions and services
(a)		
14	10.	Jewellers, leather, sports and fancy goods
15	5.	Electrical goods, household appliances
16	4.	Hardware
17	7.	Chemists and photographic goods
18	9.	Furniture and music
19	6.	Booksellers and stationers
20	12.	Household fuel merchants
21	8.	Cycles and cycle accessories
22	13.	Other retail
23	24.	Financial institutions and services
24	11.	Department and variety stores

(a) Delimitation of trait complex.

Table 6 continued -

V B centres

Rank		
1	1.	Food
2	16.	Building trades and materials; household and property maintenance
3	19.	Medical, health and social services
4	17.	Public assembly halls; entertainment centres
5	14.	Restaurants, cafes, hotels, public houses and road-houses
(d)		
6	23.	Financial institutions and services
7	20.	Professional services other than medical
8	18.	Motor trade establishments
9	3.	Apparel and drapery
10	15.	Personal services
11	21.	Educational and religious institutions
(c)		
12	22.	Offices of local government, public administration and law enforcement
13	2.	Confectioners, tobacconists, newsagents
14	5.	Electrical goods, household appliances
15	9.	Furniture and music
16	7.	Chemists and photographic goods
(a)		
17	4.	Hardware
18	12.	Household fuel merchants
19	6.	Booksellers and stationers
20	10.	Jewellers, leather, sports, and fancy goods
21	11.	Department and variety stores
22	24.	News services
23	8.	Cycles and cycle accessories
24	13.	Other retail

(a) Delimitation of trait complex.

(c) Delimitation of inner trait complex.

(d) Delimitation of inner core complex.

show the comparative rates of change of occurrence between Categories, and the comparative progressions of the ranges of Categories among the various Groups and Levels of centres.

In general, the curves shown on Figure 6 are slightly "S" shaped although this would appear less marked in Level B than in Level A. Along the courses of the curves, however, numerous steps and changes of slope indicate variations in the importance of the association of certain sets of Categories with types of centres. The breaks indicated along the curves show divisions among sets of Categories where the ranking reveals relatively greater and/or suddenly changing rates of decline as values diminish. While inspection of the curves suggests that many such breaks could be inferred, as the lower portions are reached it would not be very meaningful to attempt any differentiation because of the greater element of uncertainty in the occurrence of facilities where they are relatively scarce. Only those more important Categories are of immediate concern therefore in attempting to describe the characteristic functional structures of types of centres.

The most important set of functional categories for IIA is interpreted to extend to include the fifth rank (order of magnitude) in Figure 6. As hierarchical order increases in Level A the sets of Categories expand to include the eleventh rank for third and fourth order centres, and the twelfth rank for fifth order centres. In addition, a more particular core group of functions may be identified for VA centres as the first five ranks by order of magnitude. The specific functions which therefore characterize Level A centres in the various hierarchy groups may be seen on Table 6 above the lines separating the ranks as indicated. These sets of categories represent for this study

the counterpart phenomenon to Smailes' "trait complex" in 1944. (7) This term, which has become part of urban geographical terminology, may be used interchangeably with "set of functional categories" so far employed here.

Accepting that the trait complexes identified are characteristic of types of centres, it is interesting to note the nature of these sets. IIA centres are shown most characteristically by a trait complex which is largely service and/or institutional in nature. Categories 1 (Food), 14 (Restaurants and hotels) and part of 17 (Halls and entertainment) comprise activities based upon commercial organization but all other activities included in this complex relate either to local community social and religious activities or to those which are organized at a higher level of public authority. (8) In all, the five categories of this trait complex comprise 61.3% of all functional facilities in IIA places.

The trait complex of IIIA centres comprises the eleven categories having the largest average number of facilities (Figure 6). The break of the trend is determined in this case by the rapid rate of decline between the importance of ranks eleven and twelve and in anticipation of the stability of the twelfth and thirteenth ranked Categories in forming a step-like break in the trend of the graph. Possible breaks between the sixth and seventh ranked Categories or between the ninth and tenth are rejected, firstly, because the differences between those pairs are not as great as between the eleventh and twelfth, and secondly, because elementary community activities which are very common in lower order centres would be excluded only marginally. These include Categories 22 (Local government), 3 (Apparel), and 2 (Confectioners).

The increase of functions over the IIA centres is in Categories 19 (Medical), 18 (Motor trades), 15 (Personal services), 16 (Building trades), 3 (Apparel), and 2 (Confectioners). Only Category 19 (Medical, health, and social services) seriously outranks Categories also found in IIA places, the other additions ranking mainly after Categories held in common. The mix of activities broadens with these additions as more purely commercial functions become characteristic. In all, the eleven Categories comprise 86.8% of functional facilities to be found in IIIA centres.

IVA centres are seen to display the same core of Categories as a trait complex as do IIIA centres. There is an internal re-ordering which betrays changing significance in the magnitudes of the various components, but the ingredients of the mix remain identical. (The internal re-ordering may be noted easily by tracing the pattern of linkages in Figure 7.) Such a pattern of similarity is hardly to be expected between these two Groups of centres and specific representative centres certainly give an impression of significant differences - Gorebridge, Armadale, Penicuik, and Tranent are surely more complex than Fauldhouse, Currie, Newtongrange, and Cockenzie and Port Seton. The apparent contradiction here gives point to an observation that is raised in a general sense at the end of this Section: that the ranking of functional categories by the magnitude of the mean occurrences of facilities per centre tends to emphasize the role of activities which are organized on a relatively small scale and/or are activities which have a low threshold for their entry into the centre. It is interesting to note that this identical trait complex is less important in terms of the total functional structure at the level of IVA centres

than at IIIA. The difference appears marginal of course, 83.9% to 86.8% of mean occurrences of facilities, but given that a trait complex may be expected to be strongly dominant numerically, this difference is indicative of the greater importance of Categories which, although relatively unimportant numerically, may betray high order status. Such Categories are identified in Section II(d)(iv) below.

VA centres display, in aggregate, more prominent steps in the ranking of Categories than do other Groups (Figure 6). Twelve Categories comprise the main trait complex but within these a further refinement appears possible where an "inner core" of five is identified. Thus the most characteristic activities are found to be those of Categories 1 (Food), 19 (Medical), 17 (Halls), 14 (Restaurants and hotels), and 16 (Building trades) while the remainder of the trait complex includes Categories 3 (Apparel), 15 (Personal services), 18 (Motor trades), 21 (Educational and religious institutions), 23 (Financial institutions), 20 (Professional services), and 22 (Local government) taken in ranked order.

The nature of the activities forming the characteristic set of functions is dominantly Service as defined in the functional classification. The balance between Service and Retail categories is virtually equal, 13 out of 24 being designated Retail in nature. Only two of the twelve Categories of the trait complex for VA centres represent the Retail portion of the classification. The inference is obvious that, not only is the Service side of central place activity very important, but also its organization may be more appropriately that of smaller individual units of activity. An extension of this point may further infer that superior organization of Services, by

virtue of consolidation to take advantage of scale economies, may be less pressing and is therefore simply, and perhaps characteristically, lagging. Whatever inferences may be drawn to suggest further problems, it may be noted here that there is an almost exclusive and identical division of the functional categories at this level of centre with the division into Retail and Service of the functional classification itself. Aside from the two Retail exceptions noted already, the Categories outside the trait complex include only one Service type. This is Category 24 (News Services) representing only a relatively minor activity in this study area.

The relative importance of the trait complex is indicated by the 87.9% of all mean occurrences being found within its twelve Categories. Further, the "inner core" of five Categories includes more than one half of all mean occurrences per centre, exactly 54.2%.

The progression of categories for IIB centres displays a marked step-like form with the main drop occurring after the eighth rank. (Figure 6) These eight form the trait complex of centres of this Group and represent Categories 1 (Food), 16 (Building trades), 17 (Halls), 19 (Medical), 18 (Motor trades), 14 (Restaurants and hotels), 21 (Educational and religious institutions), and 22 (Local government). (Table 6) As is true for Level A centres, the trait complex here is almost exclusively Service as defined in the functional classification. All the Categories comprising the trait complex of IIA centres are included in that of IIB, and it will be seen that the latter is short only of Categories 15 (Personal services), 3 (Apparel), and 2 (Confectioners) to be identical with the characteristic set of functional categories for IIIA centres. Although the internal arrangements of categories

differ, this similarity in the elements of the complexes suggests that functionally IIB centres lie midway between IIA and IIIA centres. Similarly, the numerical importance of the IIB trait complex, described as 79.3% of the total mean occurrences of facilities, portrays an intermediate position between 61.3% and 86.8% for IIA and IIIA centres respectively.

IIIB centres differ from IIB only in the addition of Category 20 (Professional services), yielding a trait complex of nine categories. In a sense one is surprised inasmuch as IIIB centres are very important central places and would be expected to be demonstrably greater in functional terms than IIB centres. Three points seem relevant in this regard. First, Category 20, representing Professional services other than medical, and therefore including architects, auctioneers and valuers, funeral directors, photographers, property agents, sculptors, solicitors, surveyors, and veterinary surgeons, would seem to be a very important higher order addition on its own. Second, the process of population decline which characterizes so many of the IIB centres means that a lag effect may be observed where the functional structure of declining places does not keep pace with the facts of simple population decrease. Therefore some IIB places which used to be either the equivalent of IIIB or nearly so, may now exhibit functional structures out of line with changing circumstances. Earlston, Chirnside, East Linton, and Newcastleton are examples of relatively important IIB centres which probably exhibit this trend but centres whose populations are declining. Third, the point made when discussing IIIA and IVA centres, regarding the numerical importance of trait complexes rather than the significance of individual units which may appear, would seem to have

application here. For example, elementary schools are found in all IIB centres but in IIIB places secondary schools are also frequently to be seen. The best example is Duns where the Berwickshire High School serves the entire county. The relatively great importance of functions in IIIB centres which are not in the trait complex is reflected in the diminished proportion of all mean occurrences of facilities within; this latter proportion is 74.0%.

Moving to IVB centres, the drop in the trend of the graph after the thirteenth category is quite marked and is taken to differentiate the trait complex within the total set of functional categories (Figure 6). All categories which appear in the IIIB trait complex are retained in this succeeding group and the additions of Categories 3 (Apparel), 15 (Personal services), 2 (Confectioners), and 23 (Financial institutions) are made. With these additions the representation of Retail functions is increased from one to three but still comprises only a small proportion of the total trait complex. The importance of the trait complex in numerical terms is very high in this Group being 87.0% of the total mean occurrences of all facilities in IVB centres. The remaining 13% is divided between eleven other categories.

Although no extended discussion of the internal re-ordering of trait complexes is contemplated at this point in the discussion, it is interesting to note the dramatic rise of Categories 3 and 15 between IIIB and IVB centres. These Categories, representing apparel and drapery retailing and personal services, give evidence of the increasing role of the higher order Level B centres as central places. Apparel and drapery retailing particularly represents a dramatic increase in status because it indicates that the small drapery found

commonly in lower order centres, is now complemented by an increased number of shops selling apparel, some of them quite specialized such as the knitwear shops of Peebles, Selkirk, Jedburgh, and Kelso.

Finally, upon inspection of the VB graph in Figure 6 it appears that the most involved trait complex of all is to be found. The evidence of nesting of functions, so far incidentally referred to rather than systematically argued, leads to the expectation that more Categories will be included in trait complexes as hierarchical order is increased. In VB a steep slope occurs between Categories ranked sixteenth and seventeenth. Therefore the full trait complex is taken to include the first sixteen Categories as ranked, or a full two-thirds of the total number of Categories. This is a very large number but the evidence leads to this conclusion and the increase of three extra Categories appears entirely consistent with the trends as shown on Figure 6. The extra Categories, 5, 9, and 7, represent retailers of electrical goods and household appliances, furniture and music, and chemists and photographic goods. All these, while numerically not displacing any other Categories in the trait complex, do represent some addition of higher order activities.

Along with the complete set of characteristic functional categories, however, two inner groups of Categories may also be recognized in the same way as one was seen in the VA trait complex. The first eleven Categories ranked are recognized as an inner grouping which comprises an essential eleven Categories. "Essential" is intended to convey the meaning of "essence" in its use here and the existence of 82.6% of all mean occurrences per centre being incorporated within this set of eleven suggests that this assessment at least

indicates the correct direction of appraising their contribution to the character of the trait complex. With the exceptions of Categories 22 and 23 which respectively shift out of and into the set of eleven, the total set is identical with the first eleven of the thirteen Categories in the IVB trait complex. This indicates the strong tendency for these Categories to nest with increasing hierarchical order and this evidence is augmented by the further recognition of the first five ranked Categories which comprise a small inner core. These Categories, 1 (Food), 16 (Building trades), 19 (Medical), 17 (Halls and entertainment), and 14 (Restaurants and hotels) consistently appear in the top groupings of trait complexes and happen to coincide exactly with the first five ranked Categories in IIB, IVA, and VA. Together these five Categories include 51.2% of all mean occurrences per centre, demonstrating a strong numerical dominance for such a small number of Categories.

At this stage it seems appropriate to ask whether there is any group of Categories which one may predict as being the most important throughout the hierarchy. Such a question requires that the trait complexes be examined for their essential inner composition. It appears that the inner core group of five Categories as outlined in the preceding paragraph is this group being sought. For inspection of Figure 7 shows that these same Categories assume (with various rankings among themselves) the first five positions not only in VB but also in IIIB, and IVA as well. Further, the grouping is incomplete by one position only in two more cases, IVB and IIB. Thus, in six of the eight Groups these five Categories are almost exclusively dominant. The position of these Categories in Figure 7 is highlighted by shading. Another pair of Categories, 18 and 21, appear to be very important too but in a secondary role only. Including these two fills out the first

seven ranks solidly in IIB and IIIB, and misses by only one position in IIA and IVA. The inclusion of an increasing number of Categories in other Groups, particularly IVB and VB, and the sorting by numerical dominance, means that a tight group of characteristic Categories is less obvious beyond the seven mentioned and even then Categories 18 (Motor trades) and 21 (Educational and religious institutions) disperse within the larger trait complex although staying within the "inner trait complex" of VB. From this it may be concluded that, throughout the hierarchy above Group I, the cardinal functional components of settlement in this study area are, in order of Category numbers:

1 Food, retailing,

14 Restaurants, cafes, hotels, public houses, and roadhouses,

16 Building trades and materials; household and property maintenance,

17 Public assembly halls; entertainment centres,

19 Medical, health, and social services.

Included as key components for centres, but secondary in numerical dominance to the five listed are:

18 Motor trade establishments,

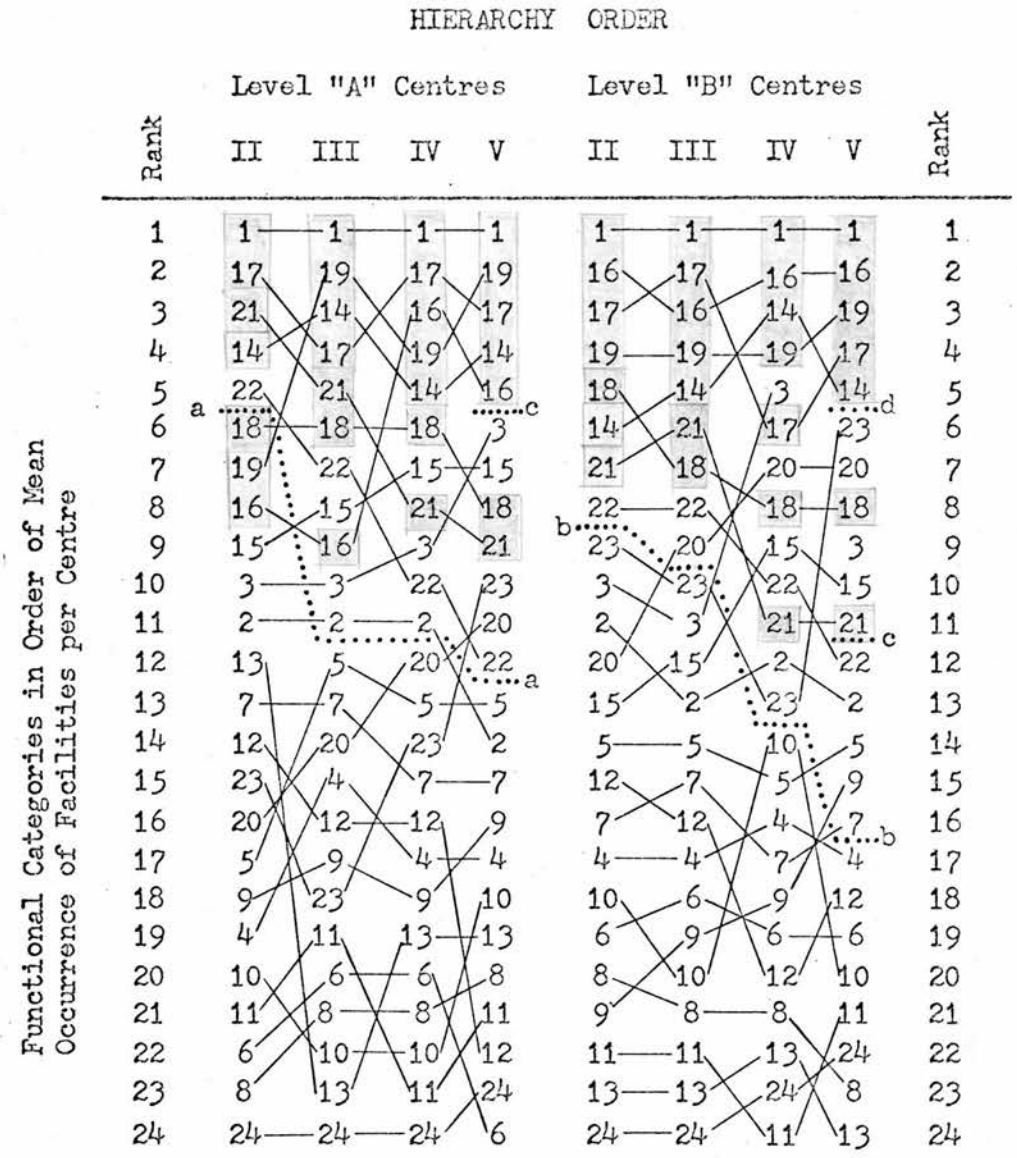
and 21 Educational and religious institutions.

(iii) The internal behaviour of trait complexes

The internal re-ordering of the importance of various functional categories is described in Figure 7. Categories are ranked in numerical order according to the mean occurrences of facilities per centre for each hierarchical order. (From Row 2, Table 4) It is clear that certain functions are higher order or have greater entry (threshold) conditions and that certain activities retain about the same numerical significance regardless of order. (9) Therefore, a certain amount of re-ordering is to be expected between the hierarchical groups.

In order to show the nature and extent of this sorting, the path of adjustment each Category makes between successive hierarchical orders is traced by a line. The resulting complex of lines displays variations which extend from no change at all (a horizontal segment) to dramatic rises and declines in position. At an aggregate level there appear marked clusters where the linkages intersect frequently.

The first major relationship to be noted is the pattern of linkages in relation to the trait complexes as identified by graphical inspection and analysis of Figure 6 in the preceding part. The trait complexes are indicated on Figure 7 according to the divisions interpreted in Figure 6 and the successive positions of the trait complexes are joined. The lines "a" and "b" thus set off these divisions in Levels A and B type centres and the lines "c" and "d" indicate the limits of the "inner cores" identified and described above. The path followed by line "a" passes through remarkably stable sections in that there are relatively few Categories experiencing great leaps or falls. This seems certainly true between IIA and IIIA, and between IIIA and IVA. However, it is not such a strong point between IVA and VA but



1) Lines a, b, c, and d represent the application of the break-points shown in Figure .
2) Lines a and b isolate the trait complexes of Level A and B centres respectively.
3) Lines c and d isolate the inner trait complexes and inner core complexes of Group V trait complexes.

Figure 7 -- Identification and internal behaviour of trait complexes.

the interpretation of the limit of the trait complex for VA in Figure 6 seems strong enough to justify its choice there. A similar general tendency may be noted for the path followed by line "b" in Level B centres. In this case the line passes through comparatively open spaces where few intersections among the linkages of Categories are seen. In the case of the "inner core" trait complexes of VA and VB centres, lines "c" and "d" maintain this pattern of occurrence where the Category linkages are least numerous.

The clustering patterns of intersecting Category linkages seem to be confined to either side of the delimitations of the trait complexes. Thus the main re-structuring and change in the relative strength of Categories as the hierarchy order changes is found within the trait complex itself on the one hand and within the balance of Categories outside the trait complex on the other. In the former case it would appear that the Categories are tending to a position of appropriate strength and importance at each level whereas, in the latter case, they appear to be jostling in anticipation of jumping into the trait complex in gradually increasing numbers. Because of the relatively small number of centres involved in the upper orders of the hierarchy, however, this latter point is suggested as a tentative inference only. Between IIA and IIIA centres six Categories augment the trait complex; none are added or subtracted in the move to IVA although some re-ordering within the complex may be noted. Between IVA and VA two Categories, 20 and 23 enter and one Category, 2, leaves the trait complex. Despite the frequent rearrangements of Categories within the trait complexes, the dropping of Category 2 is the sole example of a Category dropping out after having reached a position within the characteristic

set of Categories. No exceptions occur in Level B. This observation, coupled with the finding that trait complexes are relatively stable sets of Categories which change internally and expand by addition but do not exchange or drop Categories, leads to the conclusion that there is a distinct nesting pattern of functional growth within the hierarchy of centres. What is important at one order remains an ingredient in the increasing mix of functions at successively higher orders; what is destined to become important at a higher level may be seen to work its way upwards in the ranks towards the position where it jumps into the characteristic set of functional categories.

Examples of the major trends of Category adjustment may be revealing from a functional point of view. Within the trait complex the leading example of stability of position is, of course, Category 1 (Food retailing). It stays in first rank throughout the hierarchy. Other Categories which are relatively stable include 17 and 14 in Level A and, in addition, Categories 16 and 19 in Level B. These Categories, representing common community and commercial functions such as restaurants, public houses, hotels, public halls, building trades, household maintenance, and medical, health and social services, are those which may be taken as essential and constant regardless of hierarchical order. Beyond these, certain other functions make dramatic jumps in importance with hierarchical order. Category 19 for instance, leaps from seventh to second rank between IIA and IIIA and becomes an element of the trait complex in the process; it never drops below fourth position in any other ranking and so illustrates its necessity within these communities. Including the medical, health, and social services, this Category is less important in IIA than elsewhere, probably because the

dense network of routes and higher order centres nearby the component IIA places allows sufficient access that the functions may be more efficiently organized at a higher level. It is seen too that the numbers of facilities per centre increase with hierarchical order or else the Category would decline in rank.

Category 22, which includes local government offices, public administration and law enforcement facilities, shows a steady decline in rank but always maintains a firm position in the lower echelons of the trait complex. This Category is fairly analogous to the "attributes" recognized by Berry and Garrison and the variation in importance of the units may usually be due to an increase in scale with very reduced possibilities of a proliferation of units. Police stations, Council and District offices, and post offices are component units illustrating this point.

The point has often been made that banks are an indication of higher status among communities and, while the development of mobile banking may modify this point for lower order centres in future, there is no doubt that the existence and multiplication of competing branches in higher order centres does add to the importance of the larger places. (10) Thus from fifteenth rank in IIA (places often served by part-time sub-branches), Category 23 (Financial institutions) drops to 18th in IIIA whose component places are noted in Section II(c) ii as being somewhat "suburban" to larger and more important functional centres. It then jumps to fourteenth place in IVA and finally to tenth in VA, well within the latter's trait complex. In Level B, this Category hovers on the brink of entry into the trait complex even at IIB, maintains this position through IIIB but passes into the trait complex in

IVB. In the process it drops in rank from ninth to tenth to thirteenth position. At VB, however, a dramatic leap puts Category 23 in sixth position, adjacent to the tight inner core discussed above. In VB centres, that is in Dalkeith, Galashiels, and Hawick, banking and other concerns handling financial matters have achieved a position of importance such that the superior status of these centres may be recognized because of the emphasis given to these facilities.

The examples of the behaviour of functional categories cited here serve to illustrate the internal order of the system of activities within the hierarchy. As the hierarchical order increases, certain functions or activities which collectively control the relations among functional categories respond to the changes of scale, variety of opportunities, and greater flexibility of operation which is possible in the higher order centres. Thus some Categories are seen to rise impressively with hierarchical order. Others are of about equal relative importance in all Groups and the positions they maintain imply this. Still others, while always present, may discharge their functions without numerical proliferation, maintaining an essential position in the trait complexes, and simultaneously experiencing a relative decline in rank. The complexities of Category behaviour noted here create certain general patterns of concentration of movement in the hierarchy and of the relative lack of it. Thus the strong tendency to nesting is identified and the interpretation of the limits of the trait complexes, as made in Section II(d) ii above, is strengthened.

(iv) Ubiquitous and typical functions of centres

Although the identification of a trait complex in Section II(d)(ii) provides the basis for isolating certain Categories as dominant, the functional determination of higher status is not sufficiently described by the Categories which enter the trait complex only at higher orders. This problem arises because the graphical method of identifying trait complexes is less satisfactory at the higher orders where the numbers of centres is reduced, implying that the rates of change noted may be less reliably descriptive of the trait complexes than where the numbers of centres is greater. The purpose of this section is therefore to show which functions are characteristically associated with each Group and Level of centres without reference to functional trait complexes. The procedure followed "reverses" that employed to determine trait complexes in the sense that, in contrast to the latter, which sought the functional characteristics of centres, the centre characteristics of functions, as defined by Categories, are described now. Thus the incidence of representation of centres within Categories is the variable to be traced within the matrix of the functional classification, the data being found in Rows 3 and 4 of Table 4.

Rows 3 and 4 in Table 4 show, respectively, the number of centres represented in each functional category and the percentage of all centres which each total represents. Thus, where all centres of a Group are represented in a Category in Row 3, 100% is shown in Row 4. Clearly those Categories with 100% representation are important functionally because this means that, regardless of numerical considerations relating to the types of enterprises which comprise the Category, all centres in a given Group and Level spawn at least one of the consituent

elements of the Category. Where this level of representation is reached, the circumstances of occurrence are described as ubiquitous. However, what is also clear is that centres may be importantly represented in Categories without appearing ubiquitously and the following discussion relates to this latter consideration.

The assumption is made that 50% representation of centres in a Category may be taken to mean that the association of centres with a particular Category is typical. But it may be argued that for any given Category the approach to 50% centre representation may be very close but may fall short due to random variation. In order to avoid distortions resulting from a rigid application of an arbitrary percentage as the point of differentiation, the graphical technique employed in Figure 6 is used again in Figure 8 where the percentages of centres represented in functional categories are ranked in order of diminishing values. (From Row 4, Table 4)

In the case of IIA centres one sees immediately an example of the consideration already mentioned, that an arbitrary division at 50% might split points which appear more appropriately clustered. Therefore in seeking a break-point in the vicinity of 50%, the graph is divided somewhere in the space between the Category values plotted at 34.3% and 48.6% and the latter is included as typical. The curve for IIIA appears to break appropriately at 50% as it does for both IVA and VA. IIB continues the trend of the appropriate break being 50% although at IIIB the break must come below this figure so that the two Categories plotted as having exactly 50% representation may be included as typical. Finally, in IVB, 50% appears to be the correct division once again. From analysis of this graphical pattern then, it appears that

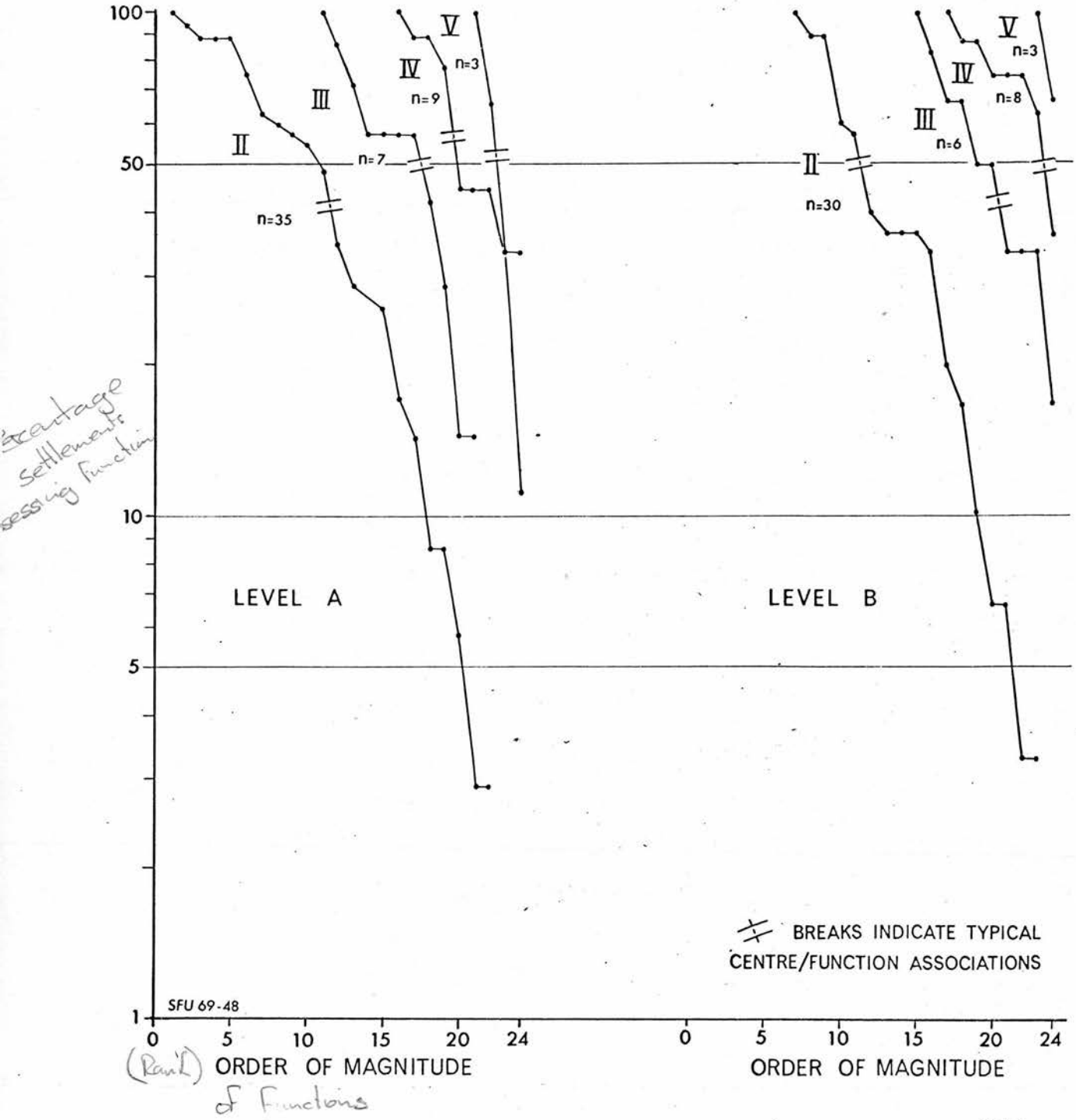


Figure 8 -- Percentage of Centres Represented in Functional Categories Ranked by Order of Magnitude

LJE

the assumption of 50% representation being typical is not denied by the facts of the data. (11)

While on the one hand the IIA curve indicates the necessity for flexibility in defining typical representation, on the other hand, the VB curve, terminating well before it descends to the 50% mark, implies that the rigidity of the framework of the functional classification allows the upward progression of the number of typical associations of centres and Categories to show clearly as the hierarchy increases in order. Thus the classification may be construed here as a backdrop, a constant, before which the progression of increasingly typical Category/centre associations develops.

Table 7 lists the categories of the functional classification and sets the representations of centres against them. Where all centres of a Group and Level are represented in a Category, this fact is indicated under the 100% column and, where centres are typically represented, this fact is indicated in the 50% column. Of all functions, only those in Category 1 (Food) command ubiquitous representation of all centres. Several come very close but miss, in the case of IIA indicating an aspect of the limited functional nature of these centres. The Categories referred to are 14 (Restaurants and hotels), 16 (Building trades), 17 (Halls and entertainment), 18 (Motor trades), 21 (Educational and religious institutions), and 22 (Local government), and these are closely followed by 3 (Apparel) and 19 (Medical) in which IIB is not shown. Referring to Figure 9 one may note that these Categories comprise, along with rank 1, the first nine ranked Categories for IIA and the first eight ranked for IIB. Inasmuch as IIB is ubiquitous in seven of these and as the remaining two are typical,

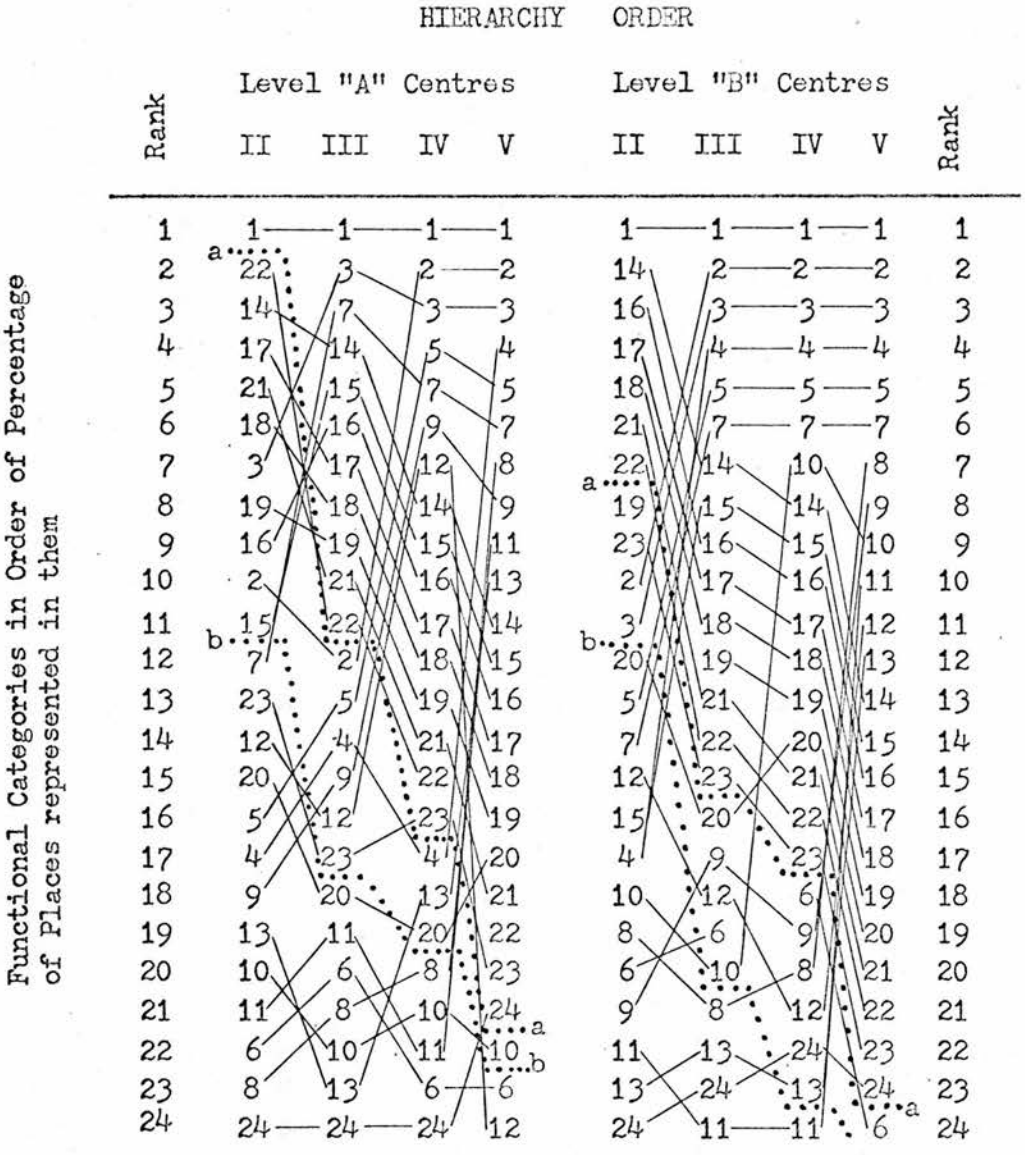
TABLE 7

UBIQUITOUS AND TYPICAL FUNCTIONAL CHARACTERISTICS OF CENTRES

Functional Categories	IIA		IIIA		IVA		VA		IIB		IIIB		IVB,VB				Tot U	Tot T
	U	T	U	T	U	T	U	T	U	T	U	T	U	T	U	T		
1 Food	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	8	8
2 Confectioners, tobacconists, and newsagents		x		x	x	x	x	x		x	x	x	x	x	x	x	5	8
3 Apparel and drapery		x	x	x	x	x	x	x		x	x	x	x	x	x	x	6	8
4 Hardware			x		x	x	x				x	x	x	x	x	x	4	6
5 Electrical goods; household appliances			x	x	x	x	x				x	x	x	x	x	x	5	6
6 Booksellers and stationers												x		x		x	0	3
7 Chemists and photographic goods			x	x	x	x	x	x			x	x	x	x	x	x	6	6
8 Cycles and cycle accessories							x	x						x	x	x	2	3
9 Furniture and music			x	x	x	x	x					x		x	x	x	3	6
10 Jewellers, leather, sports, and fancy goods								x				x	x	x	x	x	2	4
11 Department and variety stores							x	x							x	x	2	2
12 Household fuel merchants			x	x	x							x		x	x	x	2	5
13 Other retail						x	x	x						x	x	x	2	4
14 Restaurants, cafes, hotels, public houses and roadhouses	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	7	8
15 Personal services	x	x	x	x	x	x	x	x			x	x	x	x	x	x	6	7
16 Building trades and materials; household and property maintenance	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	7	8
17 Public assembly halls, entertainment centres	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	7	8
18 Motor trade establishments	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	7	8
19 Medical, health and social services	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	6	8
20 Professional services other than medical						x	x	x				x	x	x	x	x	3	5
21 Educational and religious institutions	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	7	8
22 Offices of local government, public administration, and law enforcement	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	7	8
23 Financial institutions and services			x	x	x	x	x	x		x	x	x	x	x	x	x	5	7
24 News Services							x	x						x	x	x	2	3

Notes: 1) Where all centres are represented, "x" is indicated in the "U" (ubiquitous) column.

2) Where at least half the centres are represented, "x" is indicated in the "T" (typical) column.



1) Line "a" isolates Categories having 100 per cent centre representation.
2) Line "b" delimits Categories having at least 50 per cent centre representation.
3) Lines "a" and "b" represent the application of the break-points shown in Figure .
4) Above line "a" --100 per cent-- Categories are arranged in the numerical order of the functional classification.

Figure 9 -- The progression of ubiquitous and typical associations of Categories and centres through the hierarchy.

these Categories appear the main core of commonly organized activities which find expression in low hierarchical positions.

This result, as it stands, however, yields little more than the analysis above based upon numbers of facilities. The contrast is now to be noted with the high order groups. Although in Figure 9 centres may be represented ubiquitously in most Categories, Table 7 shows the details of this representation. Category 6 (Booksellers) is entered only three times out of a possible sixteen, and each entry represents a typical association only in IIIB, IVB, and VB. No group is ubiquitous. Both VA and VB are represented ubiquitously in Category 8 (Cycles), and IVB is shown as typical there. B centres of third order and over are ubiquitously shown in Category 10 (Jewellers) although only V is represented for A Level, and only typically at that. In the case of Category 11 (Department stores), only the highest order groups are shown as ubiquitous. Category 13 (Other retail) is a residual of fairly uncommonly reported activities and therefore the ubiquitous VA and VB representation and the typical showing of IVA and IVB lend the strength of consistency of pattern to the high order nature of the functions comprising the Category. This may be set in contrast to the adjacent Category 12 which, comprising fuel merchants, would be correctly assumed to be very common at the middle and higher orders of the hierarchy. However, no representation is indicated at all in VA and the explanation lies in the quality of data for this entry. The fact is that not one fuel merchant in Bathgate and Bo'ness reported an entry in the Classified Telephone Directory, Trades and Professions, published in March 1964. This is the volume used for raw data on activities, and fuel distribution represents one of the few inconsistencies noticed in

the functional data from this source. Further expression of this particular data problem may be seen in Figure 9 where Category 12 drops from seventh rank to twenty-fourth between IVA and VA. Although the sources of data are discussed above in Section II(b), it may be claimed here that the general quality of the data is more verified than denied by highlighting this case because the consistency of pattern which is demonstrated in this study is considerable and is, of course, entirely dependent upon the quality of the initial information gathered. If the data were not reliable, many deviations of pattern would be expected.

Of the Service Categories only 24 (News services) is as exclusive as the Retail Categories indicated above for its representation by higher order groups; VA and VB are ubiquitously shown whereas IVB is typical. VA, VB, and IVB are ubiquitously represented in Category 20 (Non-medical professional services) and IVA and IIIB are typical. Category 20 is analogous to 13 (Other retail) inasmuch as activities are fairly uncommon and not easily classified unless new categories were to be created. However, the infrequent occurrence of component functions does not justify an expanded classification but the infrequency does suggest that this Category is fairly descriptive of higher order status. Lower order centres are commonly represented in all other Service Categories and these remaining Categories are therefore not considered descriptive of high order status.

The recognition of higher status in the hierarchy of places involves a different set of criteria functionally from that which describes trait complexes. Further, the approach here inverts the one used to isolate trait complexes for, rather than noting the Category

traits of centres, the incidence of centres in Categories is observed. It appears that in the study area the highest status may be indicated by the following set of Categories:

Category 11 Department and variety stores
24 News services
8 Cycles and cycle accessories
13 Other retail
20 Professional services other than medical
6 Booksellers and stationers
10 Jewellers, leather, sports, and fancy goods.

The order of listing these categories is by the incidence of centre representation. However, there is not a very strong numerical relationship arising from this and no great weight may be attached to the ordering here. What seems more important is to comment briefly upon the nature of the Categories isolated and how the incidence of this set may be interpreted with regard to hierarchical status.

Categories 11 and 24 would seem to be good indicators of high status. Not only is centre representation confined to high order places, but all fifth order centres are involved along with IVB in the case of the latter Category; further, these Categories happen to be quite specialized as to their components in comparison to other Categories. Thus Category 11 is fully described by its title, Department and variety stores, and 24 includes only news agencies (to be distinguished from "newsagents" in Category 2) and the publication or branch offices of newspapers and periodicals. Category 20 may also be thought of as a reasonably good indicator of status but because it includes quite a diversity of component elements, it offers a more generalized

form of evidence. Nevertheless, such services as are offered by solicitors, veterinary surgeons, auctioneers and valuers among others, are considered higher order and are only grouped together because of their relatively infrequent occurrence which makes special categories for them superfluous. These three Categories then may be taken as indicators of high status superior to those in the remainder in the list.

Category 8 is quite restricted in its constituent elements but they are not as evenly matched as may be desired. The three entries seem to follow a progression from baby carriages through cycles and cycle agents to motor cycles. However, the inclusion of the last could be argued to be more appropriate in Category 18 (Motor trades), but the Board of Trade classification does not do so. Because of the overlaps which do occur between motor cycle and bicycle sales, and because of the relatively infrequent occurrence of these outlets, no change is made in this study because of lack of any real evidence on which to base an alternative point of view. Taking the Category as it stands then, it may be considered a good adjunct indicator of high status.

Of the remaining Categories, No. 6 is the most consistent internally and would be roughly equal with Category 8 in importance here. Because many other kinds of retail outlets may conduct the small change trade of the bookselling and stationery business, this Category is seen as fairly specialized with its four components of booksellers, printers and stationers, stationers, and typewriter manufacturers and dealers. But the representational pattern as shown in Table 7 is one in which Level A centres are not typically shown, while

outlets are typical of only IIIB, IVB, and VB. Thus there is a heavy concentration in Level B and the emphasis in the higher order Groups does not progress according to increasing importance with order alone.

Category 13, other retail, comprises four elements: florists, handicrafts, pet stores and dog grooming, and woodworkers supplies. A florist's may be quite specialized if its business is confined to selling flowers and plants and associated goods but, like stationers, florists' activities may be largely incorporated into general stores in smaller centres though on a very small scale. Pet stores are relatively few in number and represent a quite specialized retail pursuit; dog grooming is a comparatively exotic off-shoot of the "pet business" and, as only one such location is to be found, in Haddington, it is grouped here as "retail" rather than as a personal "service". All the components of this Category then, taken together, form a disparate association among themselves but they represent relatively high order functional activities individually. Therefore representation in this Category may be expected to be by higher order centres primarily.

Finally, Category 10 (Jewellers) may be taken as only a fair indicator of status because, where a quality jeweller may be expected to indicate town prestige economically and socially, many varieties of standards of outlet confuse this position within the Category. At the lower end of the spectrum, jewellers merge with trinket shops and fancy goods stores and may be only descriptive of a resort-type retail pattern. In the case of leather and sports retailing, quality gun and golf equipment outlets (as in Kelso and North Berwick respectively) are quite indicative of a certain status inasmuch as they cater to a special clientele of relatively wealthy individuals. In the case of

the Ben Sayers golf outlet in North Berwick, there is a readily observed connection with the concentration of golfing as a pastime in the vicinity and of North Berwick as a resort town. A certain amount of this centre's status derives, in fact, from its resort function, but the marked seasonal ebb and flow of activity would require a more specific analysis of North Berwick than this study attempts. For now, one must be content with the judgement that the cyclic nature of some of the total activity detracts from the continuous importance of certain functions which appear primarily related to recreational pursuits. Therefore they are judged slightly less important than more stable functions. On the basis of both functional characteristics and the seasonal nature of activity in certain places represented, it is considered that this Category is the least indicative of hierarchical status of all seven discussed here. However, as evidence of higher status, while it should be considered as verging on the circumstantial, it should certainly not be dismissed.

Reference is made above to the observations of other authors regarding the importance of banks as indicative of hierarchical status. Category 23 includes not only banks but also insurance offices of all sorts, building societies, accountants, and hire purchase financiers. Of this group it is the banks themselves which are most commonly represented in low order centres. Thus where even IIB is shown as typical in Category 23, this marks the existence of a facility for banking in the centres of this rank; it does not indicate the importance of such a facility. It must be noted that sub-branches are counted here as banking facilities by definition, but a facility may only be open for as little as two hours per week, depending upon the needs of the centre

and area. Rumours, encountered during field work, that the banks were initiating mobile services were not followed up. But if such a development were to come about it would represent only a logical next step in trying to bring bank services to small centres - where people are often skeptical of using them. (See Section II(c)(i)) The implication is that banks as such may be changing the nature of their operations and this points to the time-bound use of such single-item characteristics of centres to describe status. The example supports the claim that an approach employing categories of activities, as is used in this study, is superior for, by isolating associated sets of functions which are typically covariant, one reaches for more meaningful functional attributes which are less subject to obliteration merely because of changing internal practices of activity organization.

Figure 9 shows the shifts of Categories through successive hierarchy orders according to whether they are ubiquitously or typically represented by centres, the columns showing the ranking of Categories in order of the percentage of centres represented in them (from Row 4 in Table 4). The lines linking the positions of Categories across the hierarchy display clustering with many intersections among linkages alternating with relatively empty spaces. The general downward cast of the pattern of linkages results simply from the procedure whereby Categories are ranked in their classification order as they reach the 100% representation stage. Where Categories are characterized by 100% centre representation, they are divided from those Categories ranked below them by line "a", and the divisions for each Group are joined together with those of adjacent columns. Similarly, Categories which have typical representation of 50% or more of centres

are differentiated by line "b". As expected, B Level centres are more frequently represented in Categories and this is especially reflected in the comparison between IIA and IIB where one and seven Categories are included respectively. Both include eleven Categories above line "b". In general, the differences between A and B Level centres are not as great after Group II is noted, although Level B centres maintain the lead throughout. The rapid increase of Categories in which centres are ubiquitously represented, however, shows the progress in importance and status of the higher order centres relative to the lower order ones. As this relationship is to be expected, no elaboration is necessary. But the point leads also to the observation that fifth order centres are ubiquitously found in virtually all Categories (21 in Level A, although if Category 12 (Household fuel) were correctly placed it would undoubtedly be 22; and 23 in Level B), reminding one again that the classification of functions is specific to this study area, and that the fifth order places should appear well represented in all Categories if the implications of the principle of the nested hierarchy are to be accepted.

With specific reference to nesting, then, the pattern of linkages may be described. Between IIA and IIIA are three clusters of linkage lines indicating an internal rearrangement among the two Groups. The upper group re-order themselves and all the eleven Categories involved cross into the 100% representation stage with the single exception of No. 2. The second cluster, between ranks 13 and 18, similarly rearrange and all but one, Category 20 (Non-medical professional services) pass over the line separating those with typical centre representation. The remaining cluster shows changes of order

of Categories, but they all remain below the 50% representation mark. Thus distinct groupings of Categories are to be observed, the first passing from typical centre representation to ubiquitous between IIA and IIIA, the second passing into the typically represented group, and the third remaining outside this group, or below 50% centre representation. The same patterns and process may be observed between IIB and IIIB with reference to linkage clusters from ranks 1 to 17, 18 to 21, and 22 to 24. Moving upwards through the hierarchy at both Levels one sees the progressive incorporation of these linkage clusters into the typical and the ubiquitous associations where the clusters disappear. Following the individual linkages across the Figure reveals that with one exception, Category 12 (Household fuel) in Level A, a Category whose validity as data is discussed above, all Categories remain in the typical or ubiquitous groupings once they have passed into them and do not drop below the level achieved. These trends include here a definite nesting pattern and there are no unexplainable exceptions in this analysis. Thus the nesting principle in functional hierarchical relationships is strongly supported in general, from a second analytical perspective, and details of the nesting process are exposed.

(v) A perspective on the functional structure of centres

The foregoing examination of the functional structures of centres builds upon the division of the hierarchy into various Groups and Levels, and approaches the identification of key functional characteristics for each division through the organizing framework of the functional classification. Trait complexes are identified for each hierarchy division and distinguishing functions for each division are also noted.

In Section II(d)(ii) the observation is made that the organizational characteristics of central place activity have repercussions on the derivation of both trait complexes and exclusively higher order functions. Thus where many small, perhaps family-based operations exist, either Retail or Service, a larger proportion of them may appear in the total functional characteristics of a place than their significance as centralizing influences would warrant. Similarly, where "rationalization" of functions has taken place and super-markets have replaced small grocers for example, the function counted would appear less important than it is - at least on economic grounds alone. Herein lies the problem. What is the "actual significance" of a small grocery in a community; are economic grounds the best method of assessing importance?

One might adopt the general position that in a system of settlement growth and expansion, scale advantages are generally sought by individual activities wishing to economize on the cost of operations, whether Retail or Service. A trend to expansion in scale but not necessarily in number of facilities may then be noted until a point of diminishing returns may be reached. Simultaneously, however, there may well be activities which may be unable to pursue scale advantages

because of cost factors, lack of prospect, or an unwillingness to risk an assured existence at one level of profit for a possible but uncertain better existence at a higher profit level. Further factors may be uncertainty and therefore fear of expansion procedures (legal involvement, for instance), and a reluctance to move to new areas if expansion on the same site is not feasible. Thus any growth of a whole centre may be patterned internally by bursts of expansion on the one hand and relative quiescence on the other.

Just as there is a point of diminishing returns for expansion in a general system of growth of activity, so a similar point may be reached in an overall pattern of decline of activity. It is quite reasonable that rationalization by scale expansion should occur when decline is the overall trend. The expansion of the East Lothian Co-operative Society into Berwickshire is an example where the activities of a Duns-based co-operative were marginal and selling out to a larger and economically sounder organization was the means of keeping the activity viable. But by the imposition of standards of profit from a larger organization, services may become more subject to an impartial evaluation of their economic worth. In the example cited, a general scaling down of van deliveries around Duns has been noted by many persons interviewed in the area. Assuming a progression in this argument to a point where an organization ceases operations, it may then be noted that all demand has not disappeared, it is merely unprofitable to pursue it in the former manner. One may expect at this point the emergence of small, perhaps community-based substitutes to cope with the residual demand. At the same time that this functional cycle is occurring, other enterprises will exist without growth in scale, without

selling out to larger organizations, and many will remain to the latter periods of a decline phase because they are part of the community in a more "personal" than economic sense.

It is thus difficult to justify a wholly economic stance in regard to the functional characteristics of places, whether the places are enjoying the fruits of growth or experiencing the sadness of decline. Further, it becomes almost impossible to know the real significance of certain functions as they are currently organized in the settlement system as a whole. In recognizing trait complexes and in distinguishing activities which impart high hierarchical status to centres where they are found, one faces the dilemma of shifting functional developments such as sketched here with reference to scale changes. The examination of these considerations would represent a major research problem which could profoundly affect any such study as this; and it is contended that a solution in terms of the meaning of the varieties and organizational characteristics of various activities would have to be more complete than one which assumed merely economic or sociological viewpoints. (12) With these considerations in mind, the constraints upon the meaning of any conclusions concerning the functions of centres are numerous. Not only is the problem in this study one of individual centres, but it is further a problem of the whole system of settlement in the study area. Major areas of rapid growth and of decline are identified by both demographic trends and by population/facility ratios. Many processes of scale expansion in these areas may be expected. The justification for employing a purely numerical technique in analyzing the functional characteristics of centres then is that, for the study area as a whole, the functional structure

is seen cross-sectionally; it may be impossible to say what activity is internally most "important" to each centre, but it is possible to isolate which activities as a group appear most often throughout the system, and which forms of activity confine themselves only to the more populous places. Taking these as fixed points, the variation of individual centres may be explored.

All centres of second order and higher, with two exceptions, have complete trait complexes for their respective positions in the hierarchy. (Details of this are shown in Appendix E.) South Queensferry is not represented in Category 2, confectioners, tobacconists, and newsagents. Obviously this appears strange because IIIA centres would be expected to possess at least one such outlet. A partial explanation for this anomaly is that often the goods sold by these facilities are also provided by general shops which function as grocery outlets also. West Calder is not represented in Category 20, professional services other than medical. This Category is seen above as indicative of relatively high order status and its absence in West Calder is taken as an expression of the ease of access to both Bathgate and especially to Edinburgh for high order services. It may be noted that these two exceptions represent the same hierarchical Group but both A and B Levels respectively. Earlier observations with regard to the deficiencies of IIIA centres were interpreted in the light of knowledge that these centres typically lie close to other more important places and therefore have not emerged strongly themselves in functional characteristics. This explanation seems valid if extended here to include West Calder, for it is only in the high order Category 20 that it is deficient and the factor of access to Edinburgh puts the centre

in a difficult competitive position.

Looking at the settlement system of the area as a whole, these individual inconsistencies pale against the general orderliness of the nested functional relationships among aggregates of centres. Not only is it possible to determine the essential functional groupings for all centres, but also characteristic sets of functional categories clearly emerge for each Level and Order in the hierarchy. A strong nesting pattern exists within the hierarchy between these sets.

Further comment is necessary to clarify the problems inherent in a cross-sectional view of settlement as it is developed here. In Section II(d)(iv) remarks about the organization of banks are related to this more general implication: each activity which recurs in centres may be viewed broadly as to whether it is primarily economic, social, or institutional in nature. If the first, facilities form parts of larger corporate enterprises concerned with profitable activity. By implication, internal organization will be prescribed to some extent and, at a higher level of policy, the very existence of a facility will be judged in the light of its capacity to be economically effective. If institutional in nature, facilities are located as part of the overall organization of the institution concerned. In the example of schools, the starting point may be taken to be a general commitment to the notion of universal education. Therefore school organization is seen to be appropriately placed in the hands of local government authorities who decide on the opening up and closing of school units, on their amalgamation, capacity, and other related aspects. Thus the organization on a systematic basis is related to the problems of the institution or corporation itself first, and

relates next to the settlement system, both reflecting and further determining its nature. Hence the changing nature of banking, of school and church organization, of policing, of patterns of co-operative society organization, and of many more activities, are all relevant to the problem of the nature of settlement but, alone, none can represent a settlement fully. Thus the question of central place characterization in functional terms demands more than the representation of hierarchical status by selected sample functions. Complexes of activity combine and interconnect to provide that status; it is these complexes which must be the objects of analysis. The following section attempts to gain some understanding of functional complexes by analyzing their diversity within centres.

(II d) FOOTNOTES

(1) In reply to the author's request for the distribution of the membership of the Old Cambus Institute, the following communication was received, in addition, from the Secretary on October 28, 1965.

> "Old Cambus W.R.I. members cover a wide area, partly because there is now no village of Old Cambus, and the members mostly come from the surrounding farms. Secondly, the Hall was erected from Rural members' fund-raising efforts and acts as a community meeting place for church and evening classes. Members who leave the district tend to keep their membership. Those who come from a distance have some specific link through friends, or relations, or former membership with the Institute"

(2) While not included as a central function elsewhere in this study, "bed and breakfast" is included at this point simply to present a complete picture of the varieties of functions with general shops as they are recorded.

(3) Telephone conversation with Rev. Chas. A. Smith, Clerk of the Synod of Lothian and Tweeddale, Church of Scotland, September 23, 1965.

(4) Interview with Assistant Chief Constable, Lothians and Peebles Constabulary, April 19, 1966.

(5) It is not possible to exclude these facilities because in several interviews people remarked that, although they normally had to see the doctor in town at his surgery, he would consent to see them at home in "the village" if necessary.

(6) Information supplied by Miss Tinch, Nursing Superintendent for Midlothian and Peebles, during an interview on April 19, 1966.

(7) Smailes, A.E., "The Urban Hierarchy in England and Wales", Geography, XXIV, 1944, pp. 41-51. On Page 42 Smailes says of secondary schools, hospitals, cinemas, and newspapers that: "These symbols of urbanism are usually found in association; they hang together as members of a trait complex. Where this is so, and the group is complete, there cannot be any doubt about recognition of a fully-fledged town." The association described is of particular expressions of facilities while the term in this study refers to associations of already aggregated functions. There is thus a type of scale difference between Professor Smailes' use of the term and its employment here.

(8) For the sake of "readability", abbreviated titles for Categories are inserted after the Category number. For the full listing of the functional classification, the reader is referred to Appendix D.

(9) To some extent this division corresponds to the "attributes" and "variates" identified by Berry and Garrison in their 1958 study, "The Functional Bases of the Central Place Hierarchy", Econ. Geog., XXXIV, pp. 145-154. Attributes are considered to be central functions which occur or are absent from places regardless of hierarchical position whereas variates are central functions which vary in number from place to place and may well reflect hierarchical positions. The authors were dealing with individual functional units (termed facilities here) in contrast to the Categories of units employed in this study.

(10) An early study citing the significance of banks is Dickinson, R.E., "The Distributions and Functions of the Smaller Urban Settlements of East Anglia", Geography, XVII, 1932. In south-east Scotland some decline of the number of branches is documented in the records of banks as reported to the Edinburgh and Leith Post Office Directory. The case of the merger of the National and Commercial Banks provides an obvious example where the rationalization of branches may reduce their number. In the 1963-64 reporting period, there were two National-Commercial Banks under one manager in Duns; in 1964-65 only one branch was reported. This information serves to strengthen the confirmation of the significance of banks for, if their numbers increase in larger centres while such rationalizations are in progress, then it may be seen that the conditions of their existence are very favourable.

(11) It should be noted that as hierarchical order increases, the number of centres ("n") decreases. Therefore an explanatory note is needed here to point out that some of the step-like features of the graph are the effect of a drop of as little as one centre represented in a Category. The less the value of "n", the greater the exaggeration. In assessing the graph, then, a step resulting from two equal and adjacent percentage values is considered relatively unimpressive; steps resulting from three or perhaps four values which are identical or very close are taken to imply a significant change of trend.

(12) Dr. Davies has suggested a scheme of "stages of generalization" in the study of retail functions which progresses from individual goods through arrays of goods to establishement types and total establishments. See "Some Considerations of Scale in Central Place Analysis", Tijdschrift voor Econ. en Soc. Geografie, Nov-Dec., 1965.

(e) The Functional Diversity of Centres

Having rejected as insufficient the idea that single indicator functions may adequately describe the comparative functional position held by a central place, the question arises as to what measures may be applied to indicate such status. Trait complexes show the essential range of functions by hierarchical order, but this yields no measure of relative status within the ranks of an order. While it is commonplace in the literature for various summary indices (often population) to be used to indicate central status, there has been relatively little debate about the merits of the application of such techniques. Boesch, however, claims that a direct numerical relationship between functions and population is virtually axiomatic and is a constant in any society. (1) Therefore, he calls attention to the "qualitative" rather than the "quantitative" description of the importance of centres, feeling that it is the range and variety of functions available which defines the importance of a place in commanding a hinterland and in competing successfully with neighbouring centres.

While one may not agree wholly that the weight of the "quantitative" measures may be discounted as a merely constant relationship within a society, there is merit in the emphasis upon the assessment of variety as a factor of central place importance and attraction. The purpose of this section is to approach a measure of the "qualitative" functional importance of centres within the study area and to identify and assess spatial distributions which result from the application of such a measure.

(i) An Index of Functional Diversity

Because few centres deviate functionally from the trait complexes defined for their respective orders, it is obvious that in order to achieve the aim of this section the relative diversity of functions for each centre must be measured. The measure used is that developed by Shear. (2)

According to Shear, two factors of diversification which should be accounted for are the evenness of the distribution among component categories and the total number of categories used. In reviewing the geographical literature for measures of diversity, he notes that the evenness factor is employed in most studies while the factor of the number of categories is neglected. The index of diversity which he outlines accommodates both factors and hence is claimed to be more general. It is expressed in the equation

$$D = \frac{9 \times 10^3}{5p_1 + 3p_2 + p_3} \qquad (1)$$

where D represents diversity, p_1 represents the percentage of the total distribution found in the category with the highest number of occurrences, and p_2 and p_3 are increments, arranged in order of decreasing magnitude, in the cumulative percentage of occurrences in successive categories.

The formula expresses algebraically an approximation of the Lorenz curve measure of diversity. Whereas the Lorenz curve requires detailed computations of the cumulative percentages of each category in the total, the plotting of these in graphical form, and the comparison of the area under the plotted curve with that under the curve representing perfect diversity, the Shear formula approaches the problem from

the point of view that, as each successive percent is calculated cumulatively, the possible range of values of the following percent is increasingly narrowed. Thus a method of predicting the plot of the whole line from the first few values is given by the formula. Shear suggests that the first three highest values are sufficient for this and therefore the formula incorporates only the values p_1, p_2, and p_3.

It is essential in using the Shear index of diversity (as in the Lorenz curve) that consistent sets of categories be used as among centres. The functional classification outlined in II(b) previously, is the basis for the application of this index in this study. However, not all Categories have centres represented in them. Therefore, in order to make it possible to measure diversity at all, the number of Categories is limited to those having centres represented in them (see Table 8). Category 2 (Confectioners, tobacconists, and newsagents) has all centres represented but South Queensferry. But, the probability is that an assumed existence of such a facility in that burgh is more accurate than its omission. Therefore, it is assumed that Category 2 should be included as one of the Categories used in the diversity measure. All other Categories without complete representation by centres are excluded. In all, twelve Categories are employed here and twelve are eliminated. It may be noted that a high degree of consistency is approached between those activities which are measured as to their diversity of occurrences in centres and those known in terms of their specific hinterlands.

The problem of consistency of Categories highlights the reason why second order centres are not included in this analysis. As hierarchical order decreases, so the number of Categories in which

centres are represented decreases. Because some second order places have low degrees of functional complexity, to include them would leave only one or two Categories with all centres represented. Therefore, the measure of diversity is confined to centres of third order and higher.

TABLE 8

FUNCTIONAL CATEGORIES INCLUDED IN THE INDEX OF DIVERSITY

* 1.	Food
2.	Confectioners, tobacconists, newsagents
* 3.	Apparel and drapery goods
* 7.	Chemists and photographic goods
*14.	Restaurants, cafes, hotels, public houses and roadhouses
*15.	Personal services
16.	Building trades and materials; household and property maintenance
*17.	Public assembly halls; entertainment centres
*18.	Motor trade establishments
*19.	Medical, health, and social services
*21.	Educational and religious institutions
*22.	Offices of local government, public administration, and law enforcement

* - Categories for which hinterland contacts are specified (Maps 9-37)

Having outlined the context of the application of the Shear index in this study, its calculation may be illustrated by the following

examples for Galashiels and Melrose, chosen for their locational proximity and for their dissimilarity of diversity indices. Percentage data are listed, for all places considered, in Table 9.

Galashiels

$p_1 = 24.3$

$p_2 = 16.2$

$p_3 = 11.0$

From equation (1),

$$D = \frac{9 \times 10^3}{121.5 + 48.6 + 11.0}$$

$D = 49.7$

Melrose

$p_1 = 16.0$

$p_2 = 16.0$

$p_3 = 11.1$

From equation (1),

$$D = \frac{9 \times 10^3}{80.0 + 48.0 + 11.1}$$

$D = 64.7$

The Shear formula specifies perfect diversity as 10N. N is represented by the number of Categories and has here the value 12. The index of perfect diversity is therefore 120. Minimum diversity is the value of D where $p_1 = 100$, or 18. Therefore, the diversity indices lie along a scale between 18 and 120, a range of 102. Values of the diversity indices for all centres are given in Table 9.

TABLE 9

FUNCTIONAL CHARACTERISTICS AND DIVERSITY INDICES

Hierarchy Group and Level	Centre	Functional Categories 1	2	3	7	14	15	16	17	18	19	21	22	Total Facilities	P1	P2	P3	Diversity Index	Ratio Pop/Cat. 1
V A	Bathgate	43	6	20	5	24	16	19	21	18	31	17	8	228	18.9	13.6	10.5	61.7	301
	Bo'ness	32	2	8	3	20	11	14	26	10	25	13	11	175	18.3	14.9	14.3	59.8	376
	Musselburgh	80	9	20	6	32	21	34	40	20	43	16	10	331	24.2	13.0	12.1	52.3	223
B	Dalkeith	39	15	14	5	23	23	18	18	15	26	13	8	217	18.0	12.0	10.6	65.9	230
	Galashiels	69	7	17	7	18	13	46	27	16	31	19	14	284	24.3	16.2	11.0	49.7	179
	Hawick	78	9	25	7	39	19	51	39	25	37	18	13	360	21.7	14.2	10.8	55.6	212
IV A	Armadale	25	2	5	2	11	10	6	12	10	9	6	5	103	24.3	11.7	10.7	53.8	329
	Bonnyrigg/ Lass.	39	5	7	3	11	8	17	16	9	18	8	8	149	26.2	12.1	11.4	50.4	247
	Broxburn	25	3	9	2	12	8	11	13	6	15	9	5	118	21.2	12.7	11.0	58.0	271
	Gorebridge	22	8	5	2	7	4	8	6	3	11	7	5	88	25.0	12.5	9.1	52.5	355
	Loanhead	22	4	5	1	5	5	11	13	7	7	5	5	90	24.4	14.4	12.2	50.7	228
	Penicuik	35	6	9	4	9	11	12	14	7	10	9	7	133	26.3	10.5	9.0	52.3	207
	Prestonpans	22	2	6	2	6	3	12	10	7	8	6	7	91	24.2	13.2	11.0	52.5	365
	Trenent	31	9	9	3	9	8	15	17	15	9	6	5	136	22.8	12.5	11.0	55.4	221
	Whitburn	13	3	3	2	7	6	6	11	11	6	5	5	78	16.7	14.1	14.1	64.3	454

Hierarchy Group and Level	Centre	Functional Categories 1	2	3	7	14	15	16	17	18	19	21	22	Total Facilities	p_1	p_2	p_3	Diversity Index	Ratio Pop/Cat.1
B	Dunbar	24	12	20	2	24	8	17	9	10	14	8	10	158	15.2	15.2	12.7	67.0	191
	Haddington	34	9	16	3	13	9	23	12	16	24	7	10	176	19.3	13.6	13.1	59.4	166
	Jedburgh	24	5	9	2	11	6	15	14	5	11	6	8	116	20.7	13.0	12.1	58.2	152
	Kelso	33	5	17	2	12	12	15	13	11	19	8	6	153	21.6	12.4	11.1	57.6	120
	Linlithgow	23	5	7	3	17	9	18	14	10	11	7	9	133	17.3	13.5	12.8	64.4	224
	North Berwick	27	12	16	3	25	10	14	10	8	19	7	7	158	17.1	15.8	12.0	62.1	154
	Peebles	30	2	11	4	21	10	19	19	11	14	9	9	159	18.9	13.2	11.9	61.6	185
	Selkirk	28	4	11	3	7	7	25	12	7	14	11	9	138	20.3	18.1	10.1	54.3	201
III A	Blackburn	7	1	1	1	5	2	2	7	4	6	5	3	44	15.9	15.4	13.6	63.9	618
	Cockenzie/ Pt. Seton	15	3	2	2	5	2	5	6	6	2	4	3	55	27.3	10.9	10.9	50.0	231
	Currie	12	3	1	1	2	3	3	3	4	14	4	4	54	25.9	22.2	7.4	44.2	345
	Easthouses	11	1	4	1	4	5	2	2	4	7	4	3	48	22.4	14.6	10.4	53.4	592
	Fauldhouse	9	2	3	2	8	4	3	7	6	5	7	2	58	15.5	13.8	12.1	68.7	532
	Newtongrange	17	5	5	2	5	3	1	5	2	8	3	4	60	28.3	13.3	8.3	47.4	292
	S. Q'ferry	12	"1"	2	2	10	3	5	6	2	5	6	4	58	20.7	17.2	10.3	54.4	246
B	Coldstream	14	6	6	3	8	3	7	10	2	6	5	4	74	18.9	13.5	10.8	61.7	88
	Duns	20	3	6	3	7	3	11	14	8	13	6	7	101	19.8	13.9	12.9	58.6	92
	Eyemouth	12	2	3	2	6	1	6	11	2	6	6	5	62	19.4	17.7	9.7	56.3	180
	Innerleithen	16	1	2	1	4	3	10	9	5	6	5	5	67	23.9	14.9	13.4	50.7	144
	Melrose	13	1	6	1	7	3	13	9	7	8	6	7	81	16.0	16.0	11.1	64.7	164
	West Calder	15	4	2	2	9	6	7	9	10	6	7	6	83	18.1	12.0	10.8	65.6	102

Note: 1) The ratio of population in centres to the number of food retail facilities (Category 1) is shown here as reference for the text.

2) p_1 represents the percentage of the total distribution found in the Category with the highest number of facilities. p_2 and p_3 represent the second and third largest percentage contributions.

(ii) Patterns of Diversity

In theory, Shear's index of diversity holds that perfect diversity exists where all categories in a classification share equally the total number of facilities. Complete lack of diversity exists where one category alone contains all the facilities of a place. Between these extremes, the index measures the amount of sharing or the concentration of facilities over the spectrum of categories. Because of the many centres considered and the range of indices represented, centres are grouped for further discussion according to the magnitudes of their diversity indices. Three divisions are recognized, being separated at the values 56.5 and 60.5. (See Appendix B.) Map 7 shows the distribution of centres by these divisions.

A striking concentration of low diversity centres occurs in the area surrounding Edinburgh, extending from Tranent in the east through Penicuik in the south and almost to Broxburn in the west. Of the thirteen centres included, only Dalkeith is not found in the lowest diversity division. Low diversity implies that the facilities of a centre are heavily concentrated in the first, that is the most numerous Category, and that the occurrence of facilities falls away significantly through the remainder of the Categories. (See Table 9.) Invariably the most numerous Category represents the number of food retailing facilities, there being only one exception, Currie. For the most part, communities found in this low diversity group near Edinburgh are introverted for food retailing; the purchase of daily or weekly food provisions is not a compelling reason for a visit into Edinburgh. Therefore it may be expected that the number of facilities in this Category reflects internal demand under prevailing retailing conditions.

The second and third most numerous Categories for the low diversity places surrounding Edinburgh are 17 and 19, respectively representing public halls and entertainment centres, and medical, health, and social services. As is the case for food purchases, activities associated with these Categories tend to be quite local and, even with the proximity of a powerful neighbour, may often be expected to "outdraw" similar attractions in the city.

The three values of "p" considered in the Shear index thus relate to facilities representing local activity. Because, however, these centres are of low diversity, it is clear that there are low frequencies of occurrence in some or all of the remaining Categories. Thus it may be inferred that for other activities, especially purchases not made on a purely convenience basis, the pull exerted by Edinburgh is very strong. Only Dalkeith appears to maintain itself functionally at a reasonable degree of diversity in locational proximity to the city. Further to this inference it may be noted that, according to Macgregor in 1953, all the centres considered here, barring two, lie within one-half hour by bus from the centre of Edinburgh. (3) The two exceptions are Penicuik and Gorebridge; but neither of them lies farther than forty-five minutes distant. The speed-up of travel since 1953 makes these centres even more accessible to the city, and Strachan notes that more than twenty per cent of the labour force in the numerous centres surrounding Edinburgh commute into the city daily. (4) The interpretation here that the functional structures of low diversity centres near Edinburgh are strongly conditioned by the attractive strength of the main centre confirms the conclusions drawn by Berry in his study in the State of Washington. (5) He noted that, as transport

favoured increased commuting into Seattle, other centres shifted their functional structures. Commonly, lower order activities flourished while higher order ones concentrated in a few places. Outside of Edinburgh itself, Dalkeith fits the latter conclusion. Decline in absolute terms of population and numbers of facilities was not seen as an appropriate concept in Berry's study, nor is it here. What was clear to Berry was that a centralization of functions has taken place across many centres in the hierarchy and that, in a general pattern of growth, relocations of facilities can betray apparent decline when in reality such shifts reflect overall growth. Such an interpretation seems to be valid and relevant here.

The distribution of centres with high diversity indices draws attention to those places lying at the east-west extremities of the Lothians. In West Lothian, Linlithgow, Bathgate, Whitburn, Blackburn, Fauldhouse and West Calder may be noted and, in East Lothian, North Berwick and Dunbar. (High diversity centres of the Borders are discussed below.) It may be expected that Falkirk and Grangemouth would exert a strong influence in the immediate vicinities of Bo'ness and Linlithgow but an examination of the contact locations for activities recorded in Maps 10 through 25 does not support a strong observation to this effect. Therefore, it is taken that their influence on the functional structure of the latter two centres is more limited than anticipated. Accordingly, they are discussed without further attention to this source of possible modification.

Linlithgow, as County Town, incorporates a large administrative structure which, in itself, does not make the number of facilities listed in Category 22 (Local government, public administration, and law

enforcement) outstanding; but because of the size of this structure, it may be expected to provide impetus for the clustering of a number of attendant facilities which service both the administrative structure and the people dependent for employment upon it. Whitburn, Blackburn, Fauldhouse, and West Calder display patterns of distribution of facilities in the Categories quite similar to each other. Whitburn, with 13 in Category 1, follows with two Categories with 11 each. Together these Categories account for 45 per cent of the total facilities; the remainder are divided among nine other Categories. Obviously the decline in facilities between each remaining Category must be relatively small; there are two further two-way numerical ties and one three-way. Blackburn has a numerical tie in the first Category. The first three Categories by magnitude include 45.5 percent of the total facilities and in the remaining Categories there are two two-way ties and one three-way. Fauldhouse has a tie of the third most numerous Category. Taking the sum of facilities in the top three Categories by magnitude, 41.4 percent of the total are seen to be included. Among the remaining Categories, there is one three-way and one two-way tie, excluding that already alluded to. West Calder similarly has a tie in the third Category by magnitude. In total, the first three most numerous Categories account for 51.8 percent of all facilities. Of the remainder there are two two-way ties and one three-way, excluding that referred to already.

In almost all the centres discussed for West Lothian, it is noticeable that the population per food retail outlet is rather high in comparison to other centres elsewhere. Compared with others of their hierarchy group and level, these ratios are: Linlithgow, 224 to Selkirk, 201, the next highest; Whitburn, 454 to Prestonpans, 365; Blackburn, 618

to Easthouses, 592; Fauldhouse, 532 (after Easthouses) to Currie, 345; and West Calder, 102 lying between Innerleithen, 144 and Duns, 92. (6) The large ratios suggest food retail facilities of considerable scale, and the concentration of food purchasing. This has a depressing effect upon the magnitude of the first Category and thereby tends to even out the distribution of facilities across the Categories. The apparently anomalous position held by West Calder is explained by its wide hinterland for food sales; the effect of this hinterland upon the ratio is not evident. The explanation of high diversity in these centres thus appears bound up in part by the implications of the exaggerated administrative structure of Linlithgow and very strongly with the trend to an increase in unit size of retail outlets for the purchase of food. This trend is more marked in West Lothian than anywhere else in the study area.

The explanation for the high indices of diversity representing North Berwick and Dunbar lies in the functional structures of these places as they reflect the importance of tourism. Both centres experience a considerable influx of holiday-makers during summer. Evidence of the "catering" function of these places is to be seen in the numbers of facilities in Category 14 (restaurants, cafes, hotels, public houses and roadhouses). In Dunbar, Category 14 is exactly equal to Category 1 in magnitude while in North Berwick the discrepancy is only the difference between 27 in Category 1 and 25 in Category 14. The even match of these two most numerous Categories implies a zero and 1.3 value of "p_2" for Dunbar and North Berwick respectively; the result is a strong measure of diversity.

Three centres, widely separated in the Lothians, are

characterized by the middle-range index of diversity. They are Bo'ness, Broxburn, and Haddington. Bo'ness is discussed below in another context. Broxburn and Haddington are both fourth order centres and Haddington also is the County Town for East Lothian. Like Linlithgow and other County Towns of the area, it counts administration of some complexity and magnitude in its functional structure. Despite their similar diversities, the total number of facilities for the relevant Categories differs as between 176 in Haddington and 118 in Broxburn. Both towns serve as relatively important central places, although Haddington's "reach" is spatially more extensive and, where administration is involved, the whole county is its hinterland.

Because Broxburn lies only one-half hour from Edinburgh's city centre by bus as compared with about 50 minutes between Haddington and Edinburgh, it may be expected that Haddington offers a more complete range of services and retail facilities. The total number of facilities is indeed greater in Haddington, as already noted; but the concern here is with the internal arrangement of these facilities as they describe functional diversity. The categories in order of their percentage contribution to the total functional structure for each centre are: 21.2, 12.7, and 11.0 for Broxburn and 19.3, 13.6, and 13.1 for Haddington. Despite the absolute differences therefore; the relative contribution of each Category within each centre appears to be very comparable. But if Broxburn is thought to lose market potential because of its greater proximity to Edinburgh, such comparability would not be expected and one should predict a greater emphasis upon locally oriented services, especially for food purchases, following the argument developed for low diversity centres near Edinburgh. It is useful to note, as in explana-

tion for other centres, that Broxburn has 247 persons per food retail outlet while Haddington has only 166. This infers that food retail facilities in Broxburn are larger on average or are utilized more effectively; but it does not necessarily infer that proportionately fewer are to be found. This is, in fact, not true as the ratio of food retail facilities to all facilities (Table 9) is approximately.02 for each place. Thus the explanation for the difference in the persons per food outlet here must be that services are more economically deployed in Broxburn than in Haddington, and this may be a function of population distribution and density. This hypothesis is suggested for further study.

Centres of the Merse area of eastern Berwickshire are all third order and represent all three divisions of the diversity index. Eyemouth is characterized by low diversity, Coldstream by high, and Duns occupies an intermediate position. One of the major influences on the functional structure of the centres is the importance of Berwick-on-Tweed which lies just beyond the study area. Its influence as it extends into the region of south-east Berwickshire may be noted in the contact locations shown on Maps 10 through 25. Keeping in mind that Berwick exerts a pull for higher order services on the hinterlands of these centres, each may be seen to possess some relatively unique position and characteristic which influences its functional diversity.

Considering its relatively small population, Duns serves a wide area of eastern Berwickshire for standard service and retail purposes and, as the County Town, serves the County in administration and in secondary education. (See Map 23.) Its dependence upon its central place functions for its existence may be inferred from the

higher number of facilities in the Categories being considered than for any other IIIB centre (101 to 83 for West Calder). The population per food retail facility at 92 is also very close to the lowest, being only slightly greater than the 88 recorded for Coldstream. The only unique aspect of Duns' functional structure is the administrative one although it is not reflected significantly in a numerical listing of administrative facilities (as defined in Category 22). Therefore the influence must be tied up in any multiplier effect which it instigates in the form of servicing either the County Offices themselves or its employees. Even that may be minimal, however, for the small size of the centre and its proximity to Berwick implies that much of the necessary servicing (suppliers, printing, etc.) would be found conveniently enough in the larger centre. As far as Duns is concerned then, one may conclude that there is an absence of any strong special function which greatly influences the overall functional diversity either to increase or to decrease it.

In some contrast, Coldstream appears to have a highly diverse functional structure. Unlike Duns, however, Coldstream lies not just at the crossroads for local movement, but at the bridging point on the Tweed which marks one of the major thoroughfares between central Scotland, especially Edinburgh, and Newcastle-on-Tyne and the south-east of England. This route offers something of a short-cut alternative to the A-1 coastal route and, in winter, is an alternative to the Carter Bar route for traffic between Glasgow and the east coast. In summer, it is common to see numerous touring coaches pass through en route to Edinburgh and, as Coldstream is the first town in Scotland along this route and lies roughly two hours from Newcastle, it is an

appropriate place to stop. Comparing the Categories of greatest magnitude with those of Duns, it may be noted that Category 14 (Restaurants, cafes, hotels, public houses, and roadhouses) is third in Coldstream but only ties for sixth place in Duns. Further, the total of eight facilities in Coldstream exceeds all other IIIB centres in this Category except West Calder with nine; but Coldstream has by far the smallest population of any comparable centre, 1,226 to 1,535 for West Calder, the closest in population. Therefore the importance of Coldstream's location with reference to a major thoroughfare between distinct regions of northern Britain is clearly expressed in its functional structure and its diversity is increased by the strengthening of this Category as the result of non-local contacts.

Eyemouth, like Duns and in contrast to Coldstream, lies away from major inter-regional routes although the distance to the A-1 is only between two to three miles. However, Eyemouth is important as a fishing port and much of its service activity reflects its own internal needs rather than the demands of a hinterland. Eyemouth lies closer to Berwick than either Duns or Coldstream, and as in the case of centres near Edinburgh and Dalkeith, appears to have relinquished certain higher order functions to Berwick. Food retail facilities and public assembly halls are both locally oriented and identify the first two Categories by magnitude. But a sharp drop occurs between the second and third largest Categories, from 11 to 6 facilities, and the remainder of the Categories have six or fewer facilities in them. Thus a greater dependence on Berwick is to be noted for Eyemouth when compared with either Duns or Coldstream. The dependence of Eyemouth upon Berwick identifies a pattern which may be noted elsewhere in the study area:

where a centre is of low relative diversity and lies in close proximity to a larger centre with high diversity, it may be suggested that the process of the centralization of functions within the hierarchy is evident. Apart from Eyemouth and its links with Berwick, Innerleithen (with Peebles), Armadale (with Bathgate), and, possibly, several centres with Dalkeith may be noted. A reverse relationship seems to obtain between Galashiels and Melrose; this is discussed later.

The distribution of contact locations for Innerleithen emphasizes its role as a centre for north-south movement along the Leithen Water and the Newhall Burn through Traquair. (Maps 10 through 25.) East-west contacts in the upper Tweed appear to be largely oriented to the more dominant centres of Peebles and Galashiels. Innerleithen therefore finds itself squeezed between larger centres to which higher order activities in its own immediate vicinity are oriented. The explanation of low diversity is therefore similar to that for centres clustering near Edinburgh and Dalkeith, and Eyemouth in relation to Berwick, that local functions remain as the centralization of higher order activity progresses upward in the hierarchy. Category 1 (Food) has 16 facilities while the next in size is Category 16 (Building trades and materials; household and property maintenance) with 10. The third is Category 17 (Public assembly halls) with 9, and the fourth, Category 19 (Medical, health, and social services) has 6. All these Categories represent essentially low order functions.

The high diversity of Peebles, however, is due in some measure to its attractions as a holiday centre. The number of facilities listed in Category 14 (Restaurants, cafes, hotels, public houses and roadhouses) is 21 which ranks closer to the 24 and 25 for Dunbar

and North Berwick than to any other IVB centre. This Category is second in magnitude for Peebles, following Category 1 (Food) and occurring before 16 and 17 (Building trades, etc., and Public halls, etc.) which tie with 19 facilities each. This even allocation of facilities among the first four Categories, couples with the fact that Peebles centralizes the administrative functions of the County thus adding weight to other lesser Categories, accounts for the relatively high diversity of this centre. Its attractions to those living in or close to Innerleithen would come in its choice in higher order retailing where, for example, it has 11 facilities in Category 3 (Apparel) to 2 for Innerleithen, and in higher order services such as dental care which Innerleithen does not provide. The contrast with the low order functional structure which predominates in Innerleithen is clear.

A simpler relationship may be seen between Armadale and Bathgate. With 103 facilities noted in the twelve Categories, Armadale has fewer than half the 228 facilities noted for Bathgate. But in Category 1 (Food), it has more than half that for Bathgate, 25 to 43, suggesting that Armadale retains this low order function much more strongly than it does other functions. For example, Category 19, (Medical, health, and social services) has 31 facilities listed for Bathgate but only 9 for Armadale; it is second in magnitude for the former but only fifth for the latter centre. Again, Category 17 (Public halls, etc.) is the second magnitude for Armadale but only fourth for Bathgate. This too is a Category of essentially low order functions. Because of these patterns of distribution of facilities among Categories, Armadale and Bathgate are interpreted as being centres of close relationship with Armadale dependent upon Bathgate

for higher order functions, and the latter supplying these for a total population which includes Armadale.

An intimate relationship appears to hold in the case of Galashiels and Melrose. Galashiels is by far the larger centre and yet it has low overall functional diversity whereas the smaller and less important Melrose has high functional diversity. The centres lie in very close proximity, so close that housing extends along much of the road between them. In order to draw out the nature of this relationship reference is made again to Innerleithen which, as the nearest IIIB centre and one which is closely bound up with the influence of larger centres, one of which is Galashiels, provides a useful comparison.

There is complete coincidence between Innerleithen and Melrose as to which Categories comprise the first four most important and, except for a tie, in which order they occur. But for Melrose the magnitudes are different; Categories 1 (Food) and 16 (Building trades) tie at 13 facilities each while 9 occur in Category 17 (Halls) and 8 in Category 19 (Medical services). Obviously with a tie between the first two which, together account for 32% of all facilities, a high degree of diversity is to be expected. The essential difference between Innerleithen and Melrose here is that whereas the former, with 16 in Category 1 (Food) and 10 in Category 16 (Building trades), displays a considerable drop between the two, the latter, with the same total of 26 between the first two Categories divides them evenly at 13 each. There is little to choose in the functional trends between these two centres beyond the fourth Category, although Melrose maintains generally higher numbers throughout. The explanation offered

here of Melrose's superior diversity is that its proximity to Galashiels allows sufficiently easy access for Galashiels to be used even for common purchases of food. There are no supermarkets in Melrose, yet its population per food retail outlet is exceeded by no other IIIB centre but Eyemouth where at least one self-service food shop is to be found. Further, the reduction of Category 1 within the total number of facilities means that a smaller percentage of facilities are found there and hence the spread of all facilities across all Categories must be more even and hence more diverse. This explanation points out the apparently contradictory situation that the larger centre, Galashiels, concentrates the lower order activities rather than the higher. The contradiction is more seeming than real, however, for the two centres are not mutually exclusive and, what is implied here is that Melrose and Galashiels are increasingly operating in concert as one centre.

Support for this point of view may be inferred from the Galashiels ratio of people per food retail outlet. At 179 this is much lower than the 212 found in Hawick, the nearest ratio of a VB centre. And this condition persists despite some large facilities in Galashiels. Therefore it seems clear that food facilities in Galashiels serve not only the inhabitants of the burgh but also those of the relatively densely settled and easily accessible immediate environs, including Melrose and several villages. (See Map 10.) An extra emphasis may be noted in that certain quantities of food may be purchased as part of the weekly shopping in this town, a firm activity pattern of the surrounding area; this fits the notional information held by interviewees that prices in Galashiels are lower than in most places - and certainly lower than in Melrose. Further, what is the same as a price reduction,

the principle of the multi-purpose trip, is to be observed in operation in such weekly trips.

Bo'ness and Linlithgow lie in close proximity in northern West Lothian. The former is characterized by intermediate diversity while the latter has high diversity and is discussed above. Considering how closely spaced these centres are, it seems reasonable to assume there is a growing interdependence between them. But litte evidence for this was apparent when field work was in progress. One doctor is known to have surgeries in both places, thus introducing an interdependence. But only in the case of Bo'ness inhabitants going to Linlithgow on an errand having to do with some aspect of County administration or planning is there a clear relationship of one place depending on the other. Further, contact locations for services shown on Maps 10 through 25 seem to indicate that these centres split their spheres of influence at about the mid-point between them. Therefore, as far as the evidence in this study shows, the diversities of these two centres are not greatly affected by the fact of the proximity of an influential neighbour. Bo'ness, with 12,029 people in 1961, obviously needs to support a variety of functions. New patterns of food retailing are evident and the population per food facility, 376, reflects the trend to larger outlets. This ratio indicates the depression of Category 1 and the result is a quite high degree of diversity within the intermediate division.

Four other centres remain to be discussed. They are Kelso, Jedburgh, Hawick, and Selkirk and have been left to this point because they do not lend themselves well to an interpretation which seems them as closely interacting with other centres or as under some dominant

influence nearby. These centres appear to deserve the description that they operate as individuals, that is, as clearly identifiable central places serving surrounding hinterlands.

Kelso and Jedburgh both are of intermediate diversity. Both depend heavily upon hinterland-serving functions for their existence as Maps 10 through 25 imply as does Map 5 where the proportions of people employed in various categories may be compared with data for the Hawick area. Only 18.5 percent of those employed are classified in manufacturing, whereas 34.1 percent are in agriculture and mining and 47.4 percent are in tertiary activities. Most of the last is to be found in these two burghs. The comparable figures for the Hawick employment exchange are 9.0, 58.4, and 32.6. These figures suggest that Hawick, the largest of the three centres, would exert far greater internal demands upon its own retail and service structure than would be true for either Kelso or Jedburgh. Therefore its hinterland, while at least comparable in extent with those of Kelso and Jedburgh, is not as crucial to the town's prosperity. The diversity indices do not vary greatly, however, with Hawick, at 55.6 lacking only two points to equal Kelso, at 57.6. The division between low and intermediate diversity falls between them but it is clear that they do not differ greatly in diversity. These three centres are seen to be very similar in having extensive hinterlands, and in offering a full range of services.

Selkirk has a lower index of diversity than Hawick but a higher one than Galashiels. One would expect it to be lower than Galashiels also but, by analogy, the special circumstances where Melrose draws off certain activities which might otherwise be found in

Galashiels, help to explain the discrepancy. Caught between Galashiels and Hawick, and dependent on two of the emptiest valleys in the study area for a major part of its hinterland (the Yarrow and Ettrick valleys), Selkirk appears doomed to slide down the scale of importance unless it can be made attractive to new industry and perhaps tourism. (7) At present, with Galashiels in particular being so accessible for higher order functions, Selkirk's Categories display the symptoms of losing higher order facilities while retaining those of lower order. Although it is the County Town, even the administrative functions are now shared with Galashiels. (8)

The patterns of diversity as identified here are seen in summary to indicate regions of certain types of similarity. The region of immediate and dominant Edinburgh influence appears to extend to all centres lying within about 40 to 50 minutes of the city centre by bus and the functional structures reflect this dominance in their apparent deficiency of higher order functions. While it is noted that centralization occurs throughout the hierarchy, it is most evident in relation to Edinburgh. The coastal centres of North Berwick and Dunbar reflect seasonal demands upon their functional structures whereas this is much less so for Eyemouth along the same coast. Eyemouth is one of the centres closely influenced by Berwick, but each of Eyemouth, Duns, and Coldstream have particular and varying demands which affect their functional structures. The heavy dependence of Eyemouth upon Berwick, however, is parallelled in the cases of Innerleithen and Peebles, and Armadale and Bathgate, whereas a greater degree of complementarity is to be noted between Galashiels and Melrose. Other centres appear to lead fairly independent existences without the complications of nearby

places upsetting what appears to be a "standard" diversity for centres which thrive as hinterland-serving central places. These include, apart from Duns, Haddington, West Calder, and possibly Broxburn and Coldstream, the larger burghs of the central and western borders, Kelso, Jedburgh, Hawick and perhaps Selkirk.

The dependent nature of some centres upon others is interpreted as illustrative of the tendency for functional centralization to be a process at work throughout the hierarchy. This interpretation is consistent with Berry's findings as already noted. However, the pattern of complementarity noted especially for Galashiels and Melrose, is clearly another functional formation if not a different process. Although not systematically investigated in this study, this finding suggests support for the hypothesis of the "dispersed city". Reference is made again in Chapter III to this concept but we may note here Burton's definition:

> "The ideal-typical dispersed city consists of a number of discrete or physically (but not necessarily politically) separate urban centres in close proximity to each other and functionally interrelated, although usually separated by tracts of non-urban land." (9)

In 1962 Berry and Mayer incorporated the concept of the dispersed city into an expanded version of central place theory. (10) They observed that it fitted neatly between central place characteristics as described for systems of individual centres and those described for shopping centres within built-up urban areas. The latter showed a degree of specialization (low diversity is implied) and complementarity, and the dispersed city was suggested as indicating a stage of changing from groups of discrete functional centres - towns - to the intra-urban

patterns of tertiary activity. (11) Although this will be briefly suggested again in a later section, the hypothesis may be advanced that areas in which dispersed city characteristics may emerge are: among the four centres of Bathgate, Blackburn, Whitburn, and Armadale; between Linlithgow and Bo'ness (and possibly Grangemouth); among Tranent, Prestonpans, Cockenzie and Port Seton; between Galashiels and Melrose; and possibly among the centres surrounding and including Dalkeith.

The index of diversity does not permit the isolation of "standard" degrees of diversity. Although for ease of explanation it is implied above that intermediate diversity, between 56.5 and 60.5, seems to characterize "true" central places as particularly expressed in Haddington, Duns, Kelso, and Jedburgh, one must also note that Broxburn and Bo'ness do not fit well in this group but have similar degrees of diversity. Further, a "true" central place only means that activity is confined to service functions, generally identified as tertiary. But other centres which could not be classified as "true" central places, may be more important suppliers of services, partly because of the multiplier effects upon services and the demands upon them that additional, perhaps secondary, activity instigates; after all, in this region, Edinburgh is the greatest central place of them all.

While making this point, it is nevertheless to be noted that diversity is affected by unusual demands of a seasonal nature (e.g. North Berwick), by the opportunity of increased and convenient interaction among centres, and by such changes as evolving forms of activities. What the index does offer, however, is a way of exposing functional characteristics as they exist in individual centres in such a way that they may be examined in distributional relations to one

another. The index provides a focus of discussion which reveals perspectives and patterns of the functional structure of the settlements of the area which is not otherwise shown.

Having applied this index, however, the conclusion is reached that it does not satisfy the conditions needed to describe centrality. It measures the variety of functional offerings in accounting for the number of Categories employed and the evenness of the distribution across them, but the units of magnitude are facilities. Thus numerous small operations are inadvertently emphasized over larger ones without any way of coping with the relative importance of the aggregates in various Categories. (12) However, it seems unlikely that this failing of the index is in itself responsible for the conclusion that the qualitative measure of functions is not the superior description of centrality that Boesch claims. For this claim merely emphasizes the difference in functional choices and omits entirely the importance of choice within the same functional offering of a centre. Thus range, rather than specialization, of function is the sole object of analysis and yet it is clear that a high degree of specialization functionally may well provide, under certain circumstances such as on the fringes of a large city, superior and therefore more attractive forms of servicing a population. It therefore appears that centrality must be expressed in such a way that it incorporates both the variety of functions and the quantitative emphasis to this variety which the size of centre permits or encourages. This theme is developed later.

II(e) FOOTNOTES

1. Boesch, Hans, "Central Functions as a Basis for a Systematic Grouping of Localities", Abstracts of Papers, International Geographical Union, 17th International Geographical Congress, United States, 1952. Publication No. 6.

2. Shear, James A., "A General Measure of Diversity", Prof. Geogr., XVII, No. 2, 1965, pp. 14-17.

3. Macgregor, D.R., "Daily Travel: A Study in Time and Distance Around Edinburgh," Scot. Geog. Mag., LXIX, No. 3, 1953, pp. 117-127.

4. Personal communication with Mr. Alan Strachan, University of Leeds. Combining personal surveys with information from published sources, Mr. Strachan notes the following percentages of labour forces in each centre which work in Edinburgh.

33 South Queensferry	62 Ratho	36 Roslin	20 Whitecraig
38 Dalmeny	90 Currie	21 Rosewell	40 Wallyford
51 Winchburgh	68 Balerno	33 Bonnyrigg & Lasswade	33 Musselburgh
8 Linlithgow	52 Kirknewton	30 Loanhead	24 Prestonpans
10 Bathgate	50 East Calder	20 Dalkeith	20 Port Seton
20 Uphall	48 Mid Calder	18 Easthouses	24 Tranent
18 Broxburn	20 West Calder	18 Newtongrange	15 Haddington
39 Newbridge	16 Penicuik	66 Danderhall	12 Pencaitland
52 Ratho Station	60 Bilston		15 Gullane
			14 North Berwick

5. Berry, B.J.L., "The Impact of Expanding Metropolitan Communities upon the Central Place Hierarchy", Annals, Amer. Assoc. Geogrs., L, 1960, pp. 112-116.

6. Population figures used in calulating this ratio are from the 1961 Census of Population (Scotland) as adjusted for this study. See Appendix C.

7. Selkirk appears to be attempting to brighten its "image" as a tourist "mecca" but the main effort so far is hardly an unqualified success. A small (and attractive) museum, recently opened in a Close just off the main square, is supported by a large parking area and the most elaborate public facilities in all the Borders. Even at the height of the "season", however, few visitors are to be encountered. Touring buses and pressing throngs are more likely to be met at a new, large-scale, quick-service restaurant, set in its parking lot at the junction of the A7(T) and the A699 on the southern edge of the burgh.

8. Resentment at the apparent success of Galashiels is often encountered in and around Selkirk. Even institutionally this attitude is evident. In the County Education Offices (located in Galashiels) individuals confided anecdotes which illustrated such feelings within the school system.

9. Burton, Ian, "A Restatement of the Dispersed City Hypothesis", Annals, Amer. Assoc. Geogrs., LIII, 1963, pp.285-289.

10. Berry, B.J.L., and H.M. Mayer, Comparative Studies of Central Place Systems, Geography Branch, U.S. Office of Naval Research, NONR 2121-18, NR 389-126, 1962.

11. Although he was not specifically concerned with this issue, Dr. Jones' analysis of suburban shopping centres in Edinburgh carries relevant implications. Where the majority of shoppers travel by bus or on foot, the development of interdependent suburban shopping centres is probably less likely than where fast suburban access roads and high automobile ownership rates are common; the former pattern prevails in Edinburgh. But Jones points out access by bus does provide a pattern of alternatives as compared with what choice is available to rural dwellers usually dependent upon a more limited bus service; this is consistent with the development of a pattern of complementary centres although it is neither a necessary nor a sufficient condition for its emergence. See Jones, R., "Central Place Shopping and the Hierarchy and Location of Shopping Centres in a City: Edinburgh", Inst. of Brit. Geogrs., Study Group in Urban Geography, Aspects of Central Place Theory and the City in Developing Countries, Durham Conference, September, 1967.

12. Perhaps floor space would be a superior measure of a function but data are not uniformly available in each County. Further, any such listings would be at some variance with the list of facilities drawn up for each centre from the sources available for this study. Perhaps most importantly, there would be great difficulty in establishing whether a new, large, self-service store is equal to, for example, six, or seven, or ten smaller, traditional retail outlets. Shifts in types of merchandise, its quality, the availability of more spending power, and many other factors are involved in drawing up any such equation and one suspects that changes in the forms of retailing and servicing are proceeding now at rates unprecedented in recent years; if this is true, such an equation would lead to no lasting improvement upon the present system of counting facilities.

(f) The Integration of Functional Analyses of Centres

In this chapter several analyses of the centres of south-east Scotland are described. The functional approach is adopted throughout, from the initial identification and classification of centres to the ordering of hierarchical relationships, the enunciation of trait complexes, and the measurement of diversity. The aim here is to relate these perspectives so that an overall view of the functional structure of settlement in this region may be approached.

The correspondence between hierarchical order and degree of functional diversity is the first relationship explored. Map 8 shows the distribution of centres by their positions in the hierarchy as defined in II(c). In general the higher order centres are scattered widely over the area with lower order places interspersed in intermediate positions. This general observation does not hold as much in the more populous parts of Midlothian and West Lothian where there are concentrations of higher order centres. Next, inspection of Map 7, showing the diversity of centres in locational relationships, shows that centres of all orders in all parts of the study area display widely varying indices of diversity. Therefore, speculation that a close correlation exists between hierarchical order and diversity is not encouraged and a null hypothesis may be formulated: that there is no meaningful correlation, either positive or negative, between hierarchical order and the degree of functional diversity of centres.

Because some individual centres may well display a high degree of correspondence between these two variables, it is desirable that centres be considered in aggregate here to avoid confusing the main trends. Since the hypothesis is null, it must be rejected for any

significant association of these two variables to be suggested. Relevant data are entered on correlation of attributes tables in Figure 10.

Diversity Index

Hierarchical Order	56.5	60.5	Total
5th	3	1	2	6
4th	8	4	5	17
3rd	7	1	5	13
Total	18	6	12	36

(a) All Centres

Figure 10-- Correlation of hierarchical order and functional diversity.

Hierarchical Order	56.5	60.5	Total
5th	1	1	1	3
4th	7	1	1	9
3rd	5	0	2	7
Total	13	2	4	19

(b) Level A Centres

	56.5	60.5	Total
5th	2	0	1	3
4th	1	3	4	8
3rd	2	1	3	6
Total	5	4	8	17

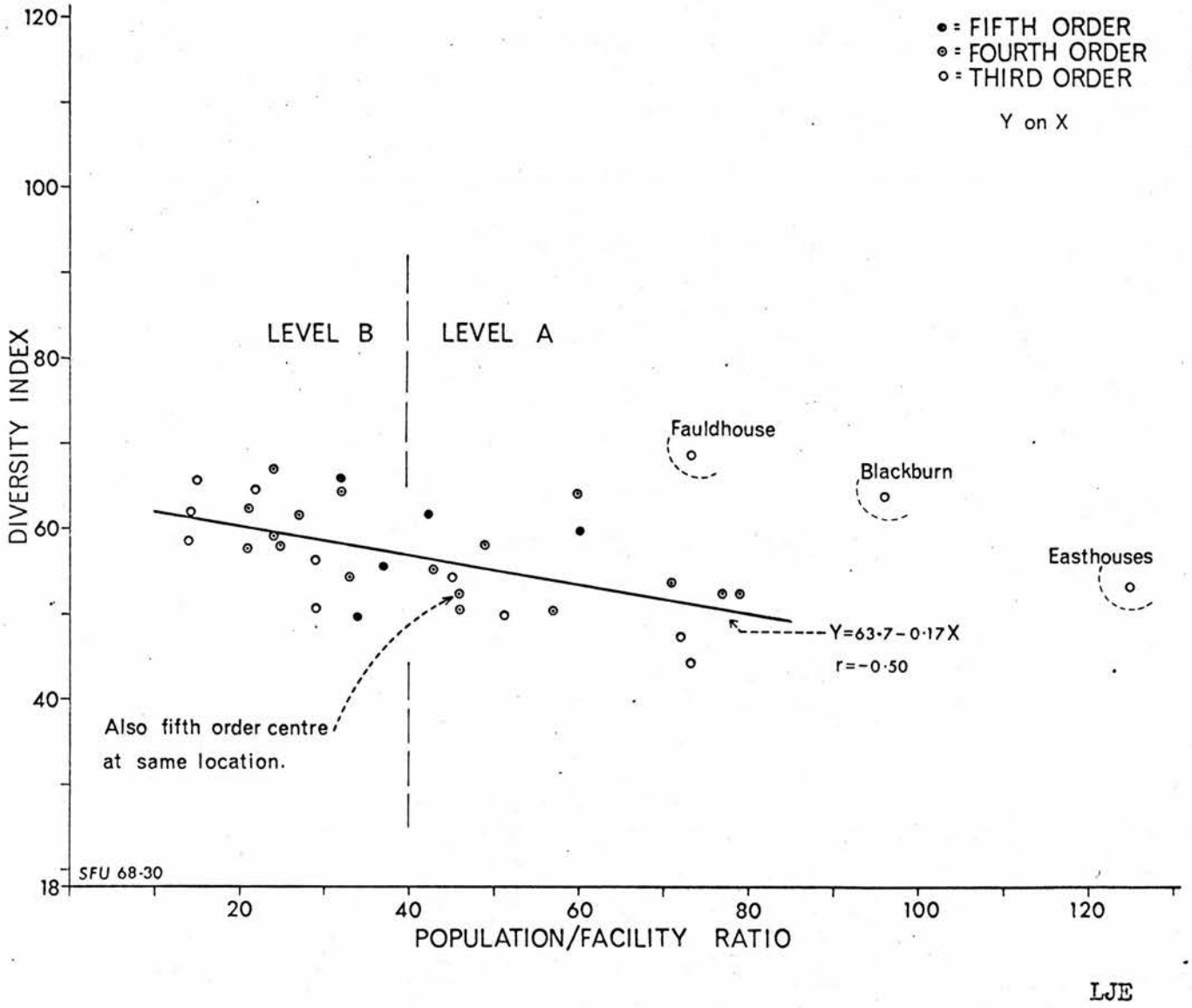
(c) Level B Centres

The first part of this Figure, (a), showing details for all centres, indicates that for each Order the greatest concentrations of occurrences are in the highest and lowest diversity divisions, with the largest number actually in the lowest. Tracing the possible positive and negative relationships of these variables does not suggest any degree of association between them. (1) Therefore it is concluded that the null hypothesis is upheld, and that there is no meaningful correlation between these variables where all centres are considered.

Breaking the aggregate of all centres down into Levels A and B, however, permits further comment. Well over half the Level A centres are of low diversity whereas roughly half the Level B centres are of high diversity. The strength of this observation is increased when it is realized that of the low diversity Level B places, one of the two fifth order and one of the two third order entries are marginal to the dividing point 56.5 (Hawick 55.6; Eyemouth 56.3) and therefore have an actual position very close to the middle division. Again there is no noticeable trend of diversity varying with hierarchical order.

If there appears to be some noticeable concentration of low functional diversity in the aggregate of Level A centres and high diversity in Level B, then the correspondence between diversity and Level is suggested. Map 7 does not yield any strong degree of separation of centres which corresponds to a diversity—Level distinction. Portions of the spatial delimitation between Levels A and B centres pass through areas where few or no centres of third order or higher are found. Yet two observations are suggestive: Dalkeith stands out as a high diversity Level B place surrounded by low diversity Level A places; and while West Calder and Blackburn both fall in the high diversity division, the former, a Level B centre, does have a higher actual diversity index than the latter, a Level A centre (65.6 to 63.9).

In order to test this relationship further, the actual population/facility ratios are substituted for the Levels A and B characterization of centres. This substitution is logical for the relationship of population and facilities is what identifies the Levels in Figure 2. Figure 11 shows the values of the diversity indices plotted against those of the population/facility ratios. The latter



LJE

Figure 11 -- Regression of Diversity Index on Population per Facility Ratio

measure is taken as the independent variable. Because the population/facility ratio is used, it is to be expected that the Levels of centres already recognized would be observed here in the pattern of point distribution. A break identifying the Levels hinges on the population/facility ratio values 39-40. Level B centres, with lower ratios, cluster in fairly formless fashion, suggesting little correlation between diversity and population per facility. Level A centres, however, display a more elongated distribution. Three centres, Fauldhouse, Blackburn, and Easthouses appear to be anomalous in that they have unusually high diversity indices and population/facility ratios. Since they are commented upon earlier, these centres are not specifically discussed here. But their positions in Figure 11, while parallelling the general trend, are sufficiently anomalous to suggest that they are centres of an entirely different character from the rest. Therefore they are excluded from further comment in this section.

Although neither the Level A nor B centres as groups would appear to display much correlation, the distributions of both, taken together in Figure 11, are consistent in their trends and form one overall elongated distribution. The coefficient of correlation (r) for these data, taken as a whole, is -0.50 and, the trend of association, as measured by the regression, is expressed in the equation $Y = 63.7 - 0.17X$. The correlation is not particularly strong but does suggest some degree of correspondence between the variables. The trend of the association is gentle with the diversity index declining at a sixth the rate that the population/facility ratio increases.

The existence of these relationships is interesting for they clearly imply that, for the south-east Scotland settlement system as a whole, some overall association of the two variables, population/facility

ratio and functional diversity is established. The Level A and B distinction further implies that conditions of servicing the population vary in terms of the dependent variable, diversity, inversely as the concentration of population in closely spaced centres. Another phrasing of this implication is that the more closely spaced are the centres, the more specialized they become. And this is consistent with the idea of the development of the dispersed city. (Burton's definition of the dispersed city is quoted previously in II(e).) Further, for predictive purposes--perhaps useful in planning applications--it may be noted that diversity varies much more slowly than the population/facility ratio. And because the Levels are clearly separate, the inference is also possible that diversity increases as centres are able to assert themselves in the face of competition from other centres. The most obvious observation is that distance from Edinburgh is distinctly advantageous in this assertion, thus reiterating the dominant role played by the city in the region.

It is clear that the two exercises of identifying the centres of the study area and of classifying their functions provide the fundamentals which underlie all subsequent analyses. How valid these frameworks are may be inferred from their application. In the analyses of this chapter it is felt that results are consistent, and explanations and direct inferences are logical, and that the identification of centres and the classification of their functions may therefore be considered both comprehensive and accurate. Subsequent analyses hinge partly upon these two bases whose merits may thus be judged again at a later stage.

Apart from the commonly applied "quantitative" approaches to

the study of settlement systems, an attempt has been made to assess "qualitative" aspects of the functional structure of centres in this area. (2) In concluding the analysis of the functional structure of centres it was noted that single "index functions" are insufficient to describe adequately the functional stature of centres except as a rule-of-thumb method and that sets of functions are required to approach this characterization. Thus the trait complexes of the various orders of centres are identified. But several points remain concerning the meaning of these.

First, apart from the case of first order centres where individual functions comprise the mix of the trait complex, the Categories of the functional classification are the functional units studied. this implies some degree of generalization which may affect particular results and may conceal small but significant functional trends from being identified. While this may be true, it may also be claimed that clarity of perspective is increased by some generalization because relatively minor differences may exist between particular facilities which, at an individual level of appraisal, would have to comprise separate functions; the effect would be to create untold numbers of individual problems of cataloguing functions for very little meaningful return in a study not specifically designed to investigate those minor variations. An associated problem for an individual-function analysis would be the problem of handling vast quantities of data; and one would need to be certain that spending considerable resources on computerized data would yield results sufficiently meaningful to warrant such an effort on individual details. In the opinion of this writer, the patterns of the functional structure are highlighted by classifying

the individual items and then concentrating upon the aggregate unit.

A second comment relates to the effect of such categorization as a stage in the process of functional development. While it is claimed above, that sets of functions must be the objects of analysis in assessing the functional structure of centres, it is also noted that individual functions are organized in a systematic fashion according to their own principles. (3) These two points in juxtaposition highlight the dilemma that different functions may "hang together" in an apparently necessary association, thereby imparting functional character to a centre; but the functions are organized apart from location, on the basis of individual aims which may be very divergent from those of other functions with which they lie in close proximity. A further extension of this is that each individual function, because it evolves according to its own principles, may be at different stages of development. Data gathered for a particular time and placed into the frameworks of trait complexes and functional categories, may therefore be describing only a featureless two-dimensional plane into which the processes of functional evolution are pressed and flattened. But it is only realistic to recall that the data for a point in time represent the mix of functions which are evidently appropriate to that time and that the associations within trait complexes and functional categories are those which represent the functional character of centres at the time of investigation. It may be that internal functional changes may be traced by repeating observations, but there is still no way of knowing whether such changes are necessary responses to surrounding developments in location or represent motivations internal to the function itself. No theory copes with this problem to the knowledge of this writer.

It is implied above that functions are located at least partly in response to the existing framework of settlement. Location is a variable which is readily identified and changes which occur in the functional structure of centres may in part be related to this variable. Further, functional mixes which represent one point in time but vary locationally point to a next step of viewing the settlement structure at another, more generalized, level than the individual centre. Characteristics of the whole system of settlement thus may be studied with the locational variable opening up the avenue for comparative and cross-sectional analysis. At this level the problems of individual functions evolving at varying rates become absorbed in the more patterned development of the whole system. And the associations of functions become more meaningful objects of attention than the distributions of individual phenomena. Therefore the next chapter is devoted to an analysis of the attraction of centres and the forms that such attraction produces in behaviour patterns. The locational variable is emphasized both directly and indirectly, the latter in the implication that the attractiveness of centres is intertwined with the internal associations of central functions; where these associations vary by location, so the relative attraction of the centres may vary.

II(f) FOOTNOTES

1. A normal chi-square test of this data is inappropriate because the expected frequency for each cell does not exceed 5. This renders the test unreliable and the discussion thus turns upon inspection of Figure 10.

2. Boesch, Hans, op.cit., footnote 1 in section II(e). These terms are those employed by Boesch.

3. As discussed, for example, with reference to the systematic organization of functions in section II(d)(v), especially in the final paragraph.

CHAPTER III

THE SPATIAL EXTENT AND INTENSITY OF FOCAL ACTIVITY

While it is claimed that some classification of functions is a necessary generalization of data in this study, it is also obvious that, in seeking responses to questions concerning individual behaviour as related to central functions, the questions must be specific; a reasonable response may be anticipated to the question, Where do you go to consult your doctor?, but no real success should be expected if the question were to be phrased, Where do you go for medical, health, and social services?

This chapter deals therefore with the specific distributions of contacts for various purposes with centres. Later generalizations are predicated upon these identifications.

Each of the specifics enquired after in gathering the data for this chapter represents an example of one of the individual functions within Categories of the classification. Lest the distributions of contact locations for the specific functions be thought wholly representative of the Categories, however, it is to be noted that specific functions do not necessarily have similar contact locations. Thus, in the Category already referred to, Medical, Health, and Social Services, dentists and doctors are shown to have markedly different contact locations from each other, and from this standpoint to align themselves more closely with laundries and dry cleaners, and banks and chemists respectively. These comments imply that the distributions of central activity must be made from two points of view:

first, the systematic distribution of central contacts for specific purposes must be described for the study area and, second, the aggregate effect of all distributions as related to centres must be analyzed. It is the latter form of investigation which allows characterization of centres in terms of their relative attractiveness, and therefore of the form of activity distributions over the whole study area.

The chapter is divided into three main parts. The first deals with questions of data and procedure, the second analyzes the spatial distributions of central activity, the third analyzes the spatial intensity of distributions over the study area as a whole and describes the aggregate forms these distributions take.

(a) Data Sources and Conditions

It became clear at an early stage of data collection that only inadequate and unreliable information was available through interviews with most persons who, by virtue of their trade or profession, attracted people to a centre. The difficulties of this approach made it necessary to undertake an extensive survey of the countryside to determine, as precisely as possible, the spatial orientations of personal activity.

The spread of interview locations is shown in Map 6. At some places an unsatisfactory interview made a second necessary but in most cases a person was sought who could describe the comings and goings, for example, of the food vans which integrate these points of settlement so effectively with the centres of the area. There are two general reasons for the occurrence of more than two interviews

at a place, however, and they are more important than the infrequent cases of non-co-operation. First, interviews were conducted in first order centres. They often include a farm and usually (but not always) have more households than has the average farm alone; thus more than one call was considered desirable. In a limited experiment some interviews were conducted in second order centres. Second, where nobody was available at the time of calling, a questionnaire, with stamped addressed envelope, explanatory form letter, and request to fill out the questionnaire was left in the door of each dwelling. Occasionally multiple returns were received from such places. Wherever there is more than one completed interview, the numbers of weekly food purchase contacts for each centre mentioned are averaged and all other results are included independently.

Interview locations were purposively rather than randomly selected because of the need to guarantee the spatial identification of the contact areas.(1) It was considered adequate and practicable to conduct an interview every two miles on average over the whole area. As mentioned in Chapter I(b), 1319 interviews were conducted in total, and some effort was made, during the field work, to conduct interviews more frequently than every two miles in the more densely settled areas. How many extra were conducted depended upon the nature of responses: where these were complex and varied, more interviews were attempted, whereas where the pattern of answers was similar time after time, fewer interviews were conducted. The varying frequencies of interviews were based not upon a fixed proportion of the population, but rather upon a combination of population density and the intricacy of functional organization. The actual situation is described in Figure 12 where the number of interviews is

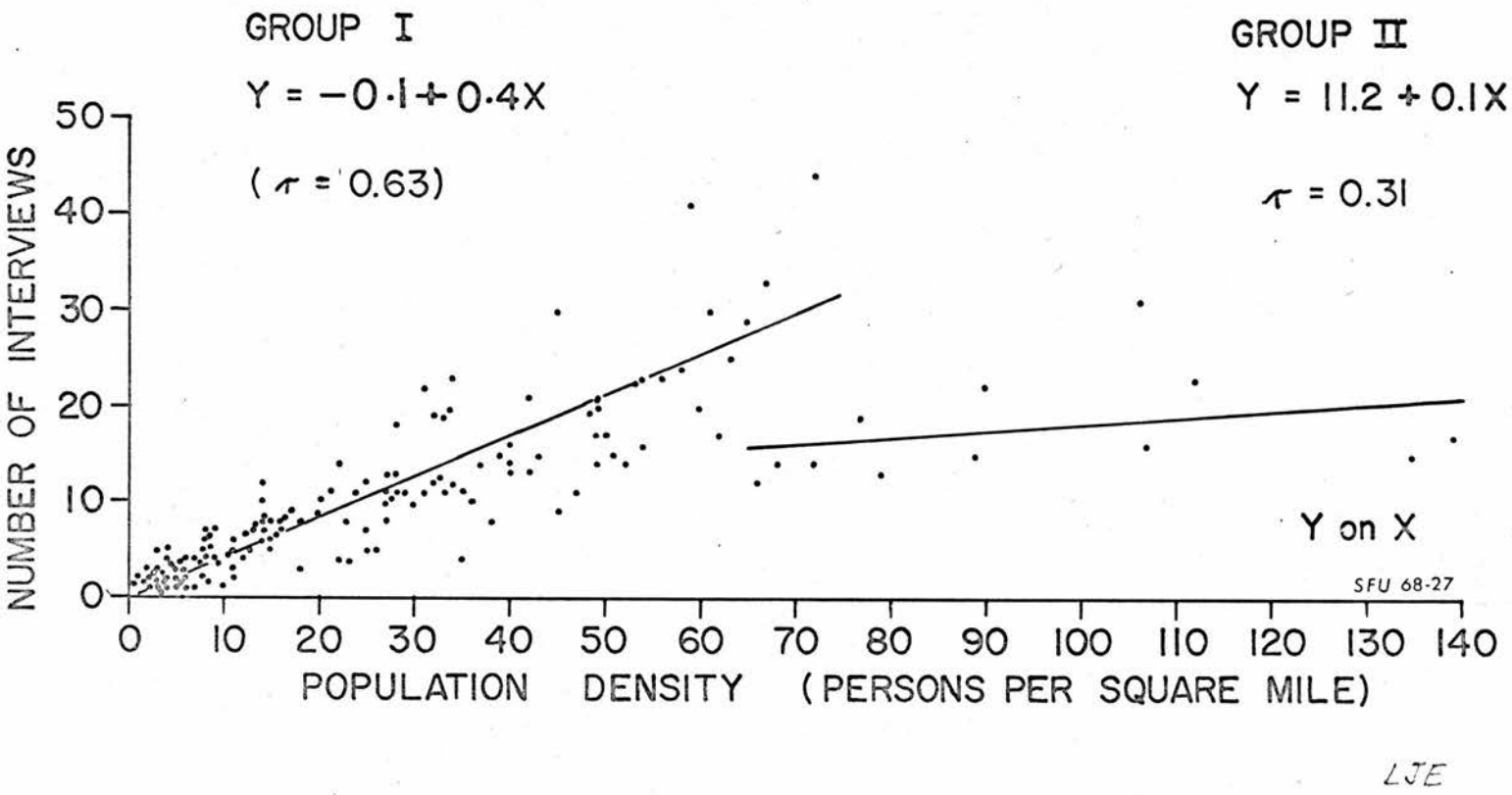


Figure 12 -- Regression of Numbers of Interviews and Population Density for 1961 (for explanation of "Group", see text)

regressed upon the population density. (Points on the graph represent values calculated for control points as outlined in Chapter I(b).) Where control areas have up to 70 persons per square mile one additional interview was conducted on average for each increase of 2 to 2.5 persons per square mile ($Y=-0.1 + 0.4X$); where the population density is very high (over 65 persons per square mile) the rate of increase in interviews is less, being about 1 per 10 persons per square mile increase ($Y = 11.2 + 0.1X$). Most of the areas of high population density lie near Edinburgh and many of the dwellings could be regarded as "suburban".

One aim in constructing the questionnaire was to place first the questions which refer to activities about which information was readily offered. Other questions of a more sensitive nature were left until the latter part of the interview (Appendix A). Not surprisingly, the first parts of the questionnaire contain more complete and reliable data than the later parts. During interviews, references to the use of a bank came at a late stage. They often drew blank looks, laughter, or some comment which apparently meant that there was no thought that a bank is for the use of "ordinary" people. Further, virtually all postal services may be obtained at the door throughout the countryside if requested. Questions relating to these services therefore were less exacting and only the information noting where a person was registered for a pension or child's allowance was included in the analysis. Again, it was often clear that the church to which the interviewee belonged was rarely, if ever, attended and therefore this information is not included in the analysis. "Correct" answers

were often given for the question regarding visits to public houses. The "correct" answer was frequently a variation of the theme that "we never go" or "my man doesn't do that but others round about do". A gentle prod often revealed a propensity for a particular public house, however, and therefore this information is included.(2) The remainder of the questions proved less reliable and responses to them are excluded from the analysis which follows.

Certain types of information are available apart from interviews. Precise school attendance information was obtained for all schools for the 1964-65 session from the County Education Authorities and from individual Head Teachers. The former provided access to lists of pupils at all schools in each county for whom transportation was supplied. Beyond that, for those who lived within the statutory "walking radius" (two miles for those over eight years old, one mile for those under eight), the Head Teachers were contacted by post with a request to indicate on a form the addresses of all pupils not receiving transport. This survey also served to correct anomalies in the transportation information.(3) The response to this survey was excellent with 162 returns out of a possible 171, representing a 94.8 per cent. response.

Information relating to social activity contact locations was obtained by a postal survey of the local Secretaries of the Scottish Women's Rural Institutes.(4) Addresses of all the membership for 1965 were obtained from responding Secretaries, the response being excellent again with 166 returns out of a possible 181, representing 91.7 per cent.

The information which forms the basis of this section, therefore, was obtained through direct interviews primarily, and through postal surveys secondarily.

III(a) FOOTNOTES

1. Peltier, Louis, "Area Sampling for Terrain Analysis", Professional Geographer, XIV, No. 2, 1962, pp. 24-28.

2. The response to the "pub" question was elicited very much more easily in the lower Merse area than anywhere else; interviewees there answered with relatively little reaction. Public houses are much more obvious at a local level in this area than elsewhere. 16.6% of all first order centres in the study area lie in Berwickshire east of a line between Birgham and Longformacus but 27.5 % of the first order centres with public houses are found there. It is tempting to think that this observation illustrates closer ties with English customs in this area than in other parts; certainly Northumbrian workers were encountered here in some numbers whereas west of Sprouston only two were met. The Merse is generally cited as being an area where improved agricultural practices were first borrowed from England and diffused to the rest of Scotland; the present observation implies that social habits too may be diffused through this area, the Merse serving as a "corridor" or "gateway" perhaps, between the two countries. See Handley, J.E., Scottish Farming in the Eighteenth Century, Faber and Faber Ltd., London, 1953, pp. 314.

3. As the school year progresses, children's birthdays affect the transportation lists drawn up at the start of the session. But lags of varying sorts and duration are involved, sometimes due to the date of reporting, or sometimes because a plea may be made to allow an older child to continue to be transported in order to accompany a younger sibling, or simply because a generous attitude is sometimes evident in the enforcement of regulations.

4. Scottish Women's Rural Institutes are taken as the example of social activities here because they are locally oriented and highly organized although entirely voluntary. The Institutes are among the most frequent and most regular users of public halls in the villages. See footnote 1 in section II(d).

(b) The Spatial Extent and Intensity of Focal Activity

(i) Food purchase contact locations

Of all the information concerning contact locations for specific activities, that relating to food purchasing is probably the most reliable as well as the most extensive. This is the category of information to which respondents displayed the least shyness. At least two reasons may be suggested to account for this. First, it is the contact activity most frequently engaged in on a day-to-day basis and is therefore a well-known routine to the householder. Second, because food retailing is dominantly by travelling vans there is nothing personal or secret about it. For these reasons, questions regarding food retailing were generally received well and answered well, and were therefore broached first during interviews. An important point about this class of information is that it has a temporal component which allows a further perspective in addition to that of spatial frequency and intensity.

Maps 9 and 10 provide two differing perspectives on contacts for food purchases. While Map 10 indicates the "reach" of the centres in terms of the distribution of food, Map 9 abstracts this data in another way to show the pattern of all contacts with centres without specific reference to any individual place or to mode of contact, either mobile shop or personal visit. Because this pattern appears to have some significance for the study area as a whole, it is discussed first and provides context for the analyses of distributions which follow.

Passing between Bo'ness and Linlithgow in the north-west of the study area, the 12.2 contacts per week isopleth may be traced

in a general south-east direction past Penicuik, Galashiels, and Hawick. Two tongue-like loops extend some distance south at Penicuik and at Hawick; in the latter case the isopleth veers sharply north again to pass Jedburgh in a general north-east orientation to the edge of the study area at Yetholm. It is easily seen that this line divides the whole area into two roughly equal parts. To the west and south of it only small areas around Peebles, Innerleithen and Broughton have as frequent weekly contact for food purchases, while to the north and east of it a great proportion of the area has at least as frequent contact, and often more. Only the Lammermuir Hill areas intrude a low frequency pattern into this half of the total area.

Further inspection of Map 9 reveals a ridge of high contact frequency extending from Bo'ness in the west to North Berwick in the east, reaching a peak outlined by the 15.1 weekly contact isopleth between Bo'ness, Uphall, and South Queensferry. The tongue-like extension to the south past Penicuik is balanced by a lobe protruding to the south-east and centring on Pathhead and the A68. The meaning of these protrusions is not immediately clear, but it may be noted that each lies in a zone of general competition for food purchase contacts and, in each case, at least one competing centre is of second order and may be engaged in an unconscious but real struggle to survive in the face of powerful challenges. These two places are West Linton which competes both with Penicuik and Peebles in the area in question, and Pathhead which competes with Dalkeith, Gorebridge, Newtongrange, Musselburgh, and Tranent. Intensification of calls by mobile shops is a very likely kind of attempt to solve the problem of loss of trade to

other places and the specific questionnaire results would seem to indicate that this suggested solution is certainly involved.(1)

The ridge of high contact frequency extends south-east of Edinburgh to Galashiels where it broadens to include the middle and lower Tweed valley, and rises to areas of maximum contact frequency around Kelso and between Duns and Berwick-on-Tweed. These latter are the most extensive areas of high contact frequency and three points appear to be related to their presence and shape. In general, considerable loss in population has occurred in the middle and lower Tweed areas (Map 4) and, as postulated above, it would seem reasonable that with declining landward markets, mobile shops would, up to a certain point, try to drain the potential market by more frequent calls in order to maintain the level of trade. At a point where such an attempt becomes uneconomic the frequency would be cut drastically; some indication of this is to be noted in the more marginally settled valleys above Duns where complaints were voiced during interviews about the withdrawal of services. This stands in contrast to the complaints in the high contact frequency areas that too many vans called, implying that the saturation point had been reached. A second point indicates that access by class A roads appears to determine the shape of the high contact area around Kelso. To the west, along the south side of the Tweed, Kelso has direct and easy access and enters into direct competition for trade with St. Boswells and Ancrum, both second order places, and Jedburgh. To the north-west, easy access is similarly found and the zone of high contact frequency in that direction centres on Gordon, another second order place. To the north-east, competition is mainly

with Coldstream and secondarily with Greenlaw, Leitholm and Duns. Kelso, then, may be seen to have easy access to certain areas where it produces competition for smaller centres which are therefore faced with the need to maintain their level of business, in the light of diminishing populations, and would appear to do so by stepping up the frequency of contact. A third point refers to the degree of nucleation of population which may affect the number of centres from which mobile shops converge. As the Chesterhill example, in connection with Pathhead shows (see Footnote 1), a large number of centres may be represented if a relatively sizable and nucleated market exists. In the middle Tweed area lie some of the most prosperous agricultural estates to be found in Scotland, and one of the features of their organization is the clustering of workers' families at certain well-defined and easily accessible spots. The effect of this pattern of nucleation may be to attract vans from a variety of centres, thus increasing the contact frequency to a level beyond necessity.(2)

A more tightly articulated and fragmented pattern of variation may be observed to the west of the 12.2 isopleth which divides the study area. Higher value loops of varying lengths pick out the upper tributary valleys of the Tweed while the low value isopleths identify the intervening uplands. This pattern not only reflects the levels of population density as between upland and valley, but also shows, through the absolute values of numbers of contacts, that considerably less interaction occurs in general than in the middle and lower Tweed areas. In West Lothian and western Midlothian fewer contacts are to be noted also - about ten per week seems to be general. "Fewer" here

is a matter of degree, however, for ten contacts per week represents a reasonably high number in any case. Paradoxically, the dense mesh of settlement in the area may also have a bearing upon keeping this number below the maxima identified elsewhere in the study area for the following reason: those interviewed gave details of the visits of mobile shops and specific shopping trips satisfactorily but could give no precise information regarding incidental food purchases made by family members who worked in town. As it seems common for wives, sons, and daughters to find jobs in nearby towns and to travel to work daily by bus, and because this pattern is much more frequent in the densely settled Lothians than elsewhere, it seems apparent that, under circumstances of a generally mobile population not immediately proximate to the major centre, an increased flexibility in methods of provisioning occurs as settlement concentrates. This view directly parallels and complements that already argued for the centres of the same part of the study area in relation to the concept of the dispersed city. (See section II(e))

Whereas the actual food purchase contacts per week are plotted on Map 9, the percentage of total contacts with individual centres forms the basic data of Map 10. Thus isopleths identify the landward gradient of influence of independent centres for food purchases; where the gradient drops, less reliance upon a single centre is evident, the extent of this dependence being usefully termed a percentage of allegiance with a centre.

The large number of lines on Map 10 dictates certain decisions regarding the cartographic presentation. First, percentage values below 23 are excluded because those below (values 16% and 9%) wander widely over the map and are very difficult to comprehend in relation to the appropriate centres. Further, it is felt that 23 per cent. affiliation with a centre

is important but below this value there is a danger of emphasizing the locations and spatial forms associated with much more incidental contacts. Second, in order to distinguish clearly between centres at Levels A and B, and to keep contacts with Edinburgh and with centres outside the study area distinct, different colours have been adopted for each of these groups of centres. Third, a system of line symbols is used to distinguish centres by hierarchical order and to indicate percentage change. Finally, because centres lying outside the study area are not graded by hierarchical order, all isopleths identifying their influence are shown by black lines, including Edinburgh.

Just as the distribution of Level A centres is limited to the Lothians, so the extent of their influence in providing food for the landward population is confined generally to the north of the Lammermuirs and Moorfoots. Only two notable penetrations to the south are found, that of Penicuik, which extends its influence south-west along the Lanark Road axis, and Gorebridge, which extends its influence south-east along the routes of the A68 and the A7. Such a distinction does not divide the study area into two simple parts, however, based upon Levels of centres. For while Level B centres completely dominate the Borders for food distribution (except at the east and west margins where Berwick and Biggar play important roles and with the minor exception of Walkerburn and equally minor "outliers" of Edinburgh's influence at Drumelzier and south of West Linton), Level A centres share the food purchase contacts to greater or lesser degree with Level B centres throughout the Lothians. Thus the Lothians display a complexity of pattern not duplicated anywhere else in south-east Scotland.

The main influence of Edinburgh upon food purchase hinterlands is to be felt to the west of the city, and is most intense in the strong commuter zone around Balerno and Currie. A retreat of its influence is evident at the axis along which Uphall, Broxburn, Newbridge and Ratho are found, reflecting the general strength of these centres for food purchase contacts. Apart from this, the shape of the area of food purchase contacts is remarkably compact. To the east, however, the city penetrates only to a limited extent - about three miles beyond Musselburgh. An outlier of Edinburgh's influence is to be found, oriented along a north-east-south-west axis with two centres of emphasis, one just south of Gifford and the other at Fala. (Two tiny outliers are found in Peebles-shire, one at Drumelzier, the other just south of West Linton.) From the distribution of Edinburgh's zone of food purchase contacts, it is clear that an overwhelming portion of the Lothians is served by the central places of these counties exclusive of Edinburgh.

While this may suggest caution in overstating the importance of a large metropolitan centre in day-to-day dominance of its immediate surroundings, it does not suggest the absence of influence. An examination of the shapes and orientations of food purchase contact areas of other centres suggests considerable influence from the city. A significant number of food purchase areas of centres close to Edinburgh are elongated roughly at right angles to a radius connecting their centres with the city. Haddington, Tranent, Dalkeith, Gorebridge (60% isopleth), Penicuik (60% isopleth), Balerno, Newbridge, and Broxburn may all be cited in this context, and are only the more

obvious centres for which the point holds true. Further, in almost all cases cited, places are eccentrically located, being displaced to the Edinburgh side of their food purchase hinterlands, thus reflecting the general difficulty faced by these places in attempting to extend their influence towards the city, and their greater relative success in doing so in the direction away from, and also concentrically around, the city. From this it may be inferred that although 23% of food purchase contacts may not be made with Edinburgh, the city's pervasive influence in its immediate environs significantly conditions the structure of contact locations with other centres of the area. This point is taken up again later in the discussion.

The group of centres identified above may be roughly thought of as an "inner" group surrounding Edinburgh. Beyond them is an identifiable "outer" group comprising Bo'ness, Linlithgow, Bathgate, possibly West Linton, Pathhead and Gifford, and Haddington, North Berwick and East Linton. The first three places mentioned are either fourth or fifth order centres and, except for Bo'ness, each appears sufficiently strong to be centrally located within its area of food purchase contacts. The strength of Bo'ness, in its thrust of influence to the east, towards Edinburgh, is quite remarkable although there appears to be an example of the point made earlier that the dense population of northern West Lothian (numerous smallholdings) invites competition from several centres. As to shape, it may be noted that these centres command compact food hinterlands, thus demonstrating, in the absence of distorting influences, their more effective control of their tributary areas.

West linton, Pathhead, and Gifford are Level B, second order

centres. Theoretically, centres of lesser order arise to service areas and populations not conveniently (economically) served by more important places. Thus West Linton appears to be "spatially bi-modal" with a zone of60% allegiance close to itself and another to the south-east between the Biggar Road and Peebles, including Hallyne. Along the route of the Biggar Road, West Linton seems incapable of maintaining the intensity of allegiance in the face of the powerful thrust of Penicuik along this axis and, as the small outlier of Edinburgh shows, that of the city as well. As Peebles is approached, West Linton's diminishing influence provides the only notable alternative to that burgh's dominance in food provisioning.

Pathhead commands a food purchase contact area which is elongated along the axis of the A68. Because of the importance of the route, however, it may be inferred that the greater ease of access along it makes the area less elongated and more compact in practice than the untransformed space such as shown here would indicate. Thirdly, Gifford commands a fairly compact, if slightly quadrilaterally-shaped, food purchase contact area. All three places are displaced from the middle of their areas in the direction of Edinburgh; given their lesser hierarchical status, this probably involves not only their relationship with Edinburgh but, more importantly, their relationship with other higher order members of the hierarchy lying between themselves and the city.

Haddington is mentioned as a member of the "inner group" but it seems transitional and may also be discussed here as a member of the "outer group" along with North Berwick and East Linton. Although somewhat elongated, Haddington's food purchase contact area is nevertheless quite compactly shaped, and the burgh itself is quite centrally placed within it.

This cannot be said for North Berwick, however, another fourth order centre with extensive landward connections. Being coastal, it is eccentrically located with reference to its landward food purchase contact locations, a point accentuated by its proximity to Gullane, a second order centre very vigorous in pursuing landward markets for food purchases. Gullane includes in its functional structure a branch of the East Lothian Co-operative Society which appears to be the driving force in extending Gullane's food hinterland in the face of the two fourth order centres, North Berwick and Haddington. In depending upon the Co-operative to be the spearhead, however, Gullane in some senses may be said to draw strength from the stronger centre, Tranent, the largest burgh in the county and the home of the Society. Such an observation raises a question which, while not analyzed in this work may become of greater significance as time passes: that where amalgamations occur in business and/or corporations grow and extend their range of operations among centres, the influence of these centres may be modified in ways not parallel with existing ideas of the extent to which centres in settlement hierarchies are influential. In the particular case at hand, the food hinterland of North Berwick is forced well to the east of what would be expected of a fourth order centre, given the precedent of others at comparable distance from Edinburgh. A further factor inviting the participation of other centres in the area just south of North Berwick is the high density of population and the high degree of nucleation of that population, including the large first order centre of Kingston. Thus, in addition to Gullane, East Linton and even Longniddry are prominent in that region and, in

fact, both these latter centres have their principal allegiance there, leaving their centres marginally located. In the case of East Linton, however, a long tail of 23% allegiance to the south to Whittingehame and Stenton gives the whole food hinterland a north-west to south-east axis which lies at right angles to the access of the A1 between Haddington and Dunbar, both stronger fourth order centres.

Stretching all across the Lothians, no centre commands the maximum allegiance, as shown for Peebles and Hawick in the Borders, of 96%. The closest approaches are in the very tiny areas around Penicuik and Newtongrange enclosed by the 84% isopleth. Bathgate, Bo'ness, Musselburgh, Gorebridge, Haddington, and Tranent are the main centres which reach the 60% level. Almost all other centres lie well below this level, being identified only at 34%. Clearly, patterns of contacts, from the point of view of the landward household, are many and varied. It is felt that a major factor in this variation is the close average proximity of settlements in this area along with a quite high road density (Map 43) providing relatively great freedom of access. Thus the disadvantages of distance and accessibility are often reduced in this area when compared with either the Tweed Valley or the uplands, and with the greater opportunity of choice thus presented to the landward population, a greater variety of centres may be patronized.

With centres as closely spaced as they are in the Lothians, and with as much freedom of choice as exists between centre and food purchase contact, it follows that much overlap between hinterlands should occur. This is obvious on Map 10 but it may be noted that there are certain patterns to this overlapping. First, there are

concentrations of it, and second, there appears to be a certain orderliness to the patterns where they interlock across the map. While there are numerous examples of overlap in the maze of isopleths, the example of the area between North Berwick and Dunbar suffices to illustrate the point that overlap appears to be not just a matter of the diminution of influence as distance from a centre increases, thus allowing the growth of another centre at some point to cope with market potential, but also a landward area, with a relatively dense population, under conditions of relatively convenient access, will attract the attention of more distant centres which compete for the available market. Classical central place theory suggests initially that such an area should spawn its own centre, and two first order centres, Whitekirk and Tyninghame, are found here; but neither is growing in a functional sense and, in the face of the attention paid this area from larger centres, neither is expected to grow functionally. Therefore the upward hierarchical concentration of functional activity, further suggested as a developmental stage in settlement according to central place principles, seems to be well represented in this instance. The example appears to be a particularly strong one in the light of its being in an essentially coastal position from which the main exit routes are often the same as the entrances. For instance, mobile shops from Dunbar, East Linton, and Tranent all approach the area along the same route through Tyninghame from the A1. In the case of Tranent, the visit is seen as an advantageous diversion by a mobile shop carrying supplies from Tranent to the branch store in Duns.(3) In any case, however, retracing of steps is uneconomic in terms of transport and time costs, indicating the value

placed upon the market of the small area in question. Centres showing an interest in the area are North Berwick, Gullane, East Linton, Dunbar, Haddington, Tranent, and Edinburgh.

In some contrast to the high degree of overlap in certain places in the Lothians, it is interesting to note the relatively low degree of overlap between centres of the Lothians and centres of the Borders in the upland areas where their respective food hinterlands meet. Accompanying this, one may also note a high degree of congruence in the way the hinterlands fit and interlock to cover the map area. Peebles and Penicuik display some overlap but rather than the isopleths forming opposing arcs only, they run parallel to each other for much of their course. Where the influences of Penicuik and Gorebridge diverge away from their mutual overlap, the northerly extension of Innerleithen's food hinterland fills the gap neatly, and its isopleths parallel those of Gorebridge for several miles. Continuing eastward, two second order places, Stow and Lauder, appear to cramp Galashiels influence to the north. Although Galashiels overlaps slightly with Gorebridge, it is Stow and Lauder which appear able to penetrate the food hinterlands of both the larger centres. In the small area north of Lauder, where Gorebridge's influence terminates and that of Tranent and Edinburgh retreat northward, Lauder's food purchase contact area interlocks nicely and overlaps with the tail-end of Pathhead's contact area. Between Lauder's contact area and that of Duns lies an unpopulated upland where no allegiance to centres is shown. Beyond this, Duns may be seen to extend its food hinterland to fit well with those of Edinburgh, Tranent, and Haddington, and in part of the contact zone, with Dunbar. More conventional forms of overlap appear between

Duns and Gifford and between Duns and Dunbar in the latter's southerly extension of its food purchase contact area inasmuch as the isopleths form a dominant pattern of opposing arcs. In all, there is the impression of great orderliness in the contact zones between food hinterlands of Lothians centres and Borders centres. This is consistent with the point developed above that overlap occurs in part because of the attraction of a population which is thought to provide a potential market; in this case, population is minimal in the upland areas, and the opposing centres appear to have worked out the shape of their contact areas in a remarkably congruent manner in the apparent absence of the need to compete for markets.

Throughout the Lothians there occur only a few minor instances where allegiance with a particular centre reaches 84%. Two small zones on the edge of the study area in south-west Midlothian depend upon West Calder and Fauldhouse to this degree, as do minor areas immediately surrounding Penicuik and Newtongrange. Much more of the area, and many more centres, are only associated to the 60% level of allegiance for food purchase contacts. The places concerned here are Bathgate, Bo'ness, and Musselburgh, all fifth order centres, along with Gorebridge, Tranent, and Haddington, all fourth order centres, and Uphall, Ratho, Rosewell, and East Linton, all second order. In contrast, three Borders centres achieve almost complete domination of parts of their respective food purchase contact areas. These centres, Hawick, Peebles, and Newcastleton are fifth, fourth and second order respectively; in each case they lie adjacent to the lightly populated uplands and Peebles and Hawick each command the entry into a valley in which the inhabitants are almost entirely reliant upon these centres for provisions. The area of 96%

allegiance at Peebles extends south into the Manor Valley and north for a little way into the uplands above Hallyne where overlap with West Linton is observed. Hawick dominates in Teviotdale while Newcastleton dominates in the valley of the Hermitage Water, a lightly populated upland valley with such small market potential that no effort is made by Hawick vans to penetrate it. Paradoxically, Hawick is very prominent in the area about Newcastleton itself, and the latter's predominance is therefore confined to the less attractive and less populated zone of the Hermitage. Hawick's penetration to the south to encircle Newcastleton represents a significant deviation of the shape of its hinterland; a complementary deviation occurs to the north to encircle Selkirk and Lilliesleaf. Both deviations are of less intensity than Hawick commands in Teviotdale, but in absolute terms are clearly seen as worthwhile by the mobile shops which bother to compete in this way. It appears that these deviations conform to the general point developed earlier that concentrations of market potential have considerable effect upon the shape of food hinterlands. But the areas of most intense allegiance may not be only those immediately surrounding centres, but may also be areas which have either relatively little market potential or are difficult of access except to one centre which "guards" the area, or some combination of both.

The only Borders centres which command an allegiance beyond the 60% level are Biggar which lies just west of Peeblesshire and is not itself part of the study, and Lauder, already discussed. Replies in interviews indicate a high degree of reliance upon Biggar in western Peeblesshire and, apart from the influence of Berwick-upon-Tweed in the

eastern Borders, the importance of Biggar as an outside centre in the study area is quite exceptional. Taken simply from the standpoint of rivalry between centres, however, the overlap between Biggar and Peebles appears to result in a very regular shift in allegiance from one centre to the other as the distance between them is traversed.

Peaks of allegiance achieved by other centres exceed 60% but do not reach 84%. These places, listed by order are Galashiels, fifth order, Selkirk, Jedburgh, and Kelso, fourth order, and Innerleithen and Eyemouth, third order. Second order centres which appear at this level of allegiance include Coldingham and Stow. Stow's 60% isopleth is found in the vicinity of Fala, however, and represents one of the few attempts of a Border centre to take advantage of relatively densely populated localities to the north.

Of the high order centres displaying a 60% allegiance, only the contact area of Selkirk is not very compact in shape. It extends south-west to dominate (and to share) the market potential of the Yarrow and Ettrick valleys. It extends north-east slightly to take advantage of the greater potential of the middle Tweed area. Its most intense allegiance is found nearby in the Yarrow and Ettrick, however, before competition, funnelled across the hills along routes from Innerleithen and Hawick, is encountered. The town's position with respect to its food purchase contact area is quite eccentric, and it stands in a "gateway" relationship to its valley hinterlands to the south-west. Unfortunately for Selkirk, the valleys have depopulated considerably, settlement is scattered,and they may be reached relatively easily from the south-west along good roads, and along feeder roads from the north

and south-east. Thus there is little prospect of Selkirk's being able to count on the potential of this area backing up the prosperity of the burgh; it must compete in the face of powerful challenges from other important centres, notably Hawick, Galashiels, and the emergent St. Boswells.

Galashiels, a fifth order centre, is commonly thought to be a more important centre than either Jedburgh or Kelso, both fourth order places. All three centres achieve a level of 60% allegiance, yet it is curious that, given its hierarchical superiority, Galashiels should extend its influence over smaller areas than either Jedburgh or Kelso. Two circumstances may be described to account for the apparent anomaly. The first is that competition for Galashiels to the north and west is more severe given the size and strength of the centres of Innerleithen and Peebles particularly, along with Stow. All three centres have manufacturing concerns which provide the bases for larger populations than their central place activities could themselves support. Further, there is little incentive for any of these centres seriously to "raid" more territory at a greater distance because of the low market potential in the lightly populated Peeblesshire valleys and to the north along the Gala Water. To the south-east of Galashiels, however, the market potential is much greater, the area being among the most densely populated in the Borders and having numerous villages. It is clearly worth some effort to take advantage of this potential and Galashiels' food hinterland extensions indicate how successful is the effort in the face of evident competition from other, but smaller, centres. In this context the point emerges that, in absolute terms, the returns to Galashiels from a 23% or 34% allegiance zone, may

well be greater than from a 60% or more zone in a less populated area. Therefore a decline of isopleth values is not indicative of a decline in the economic meaning for a centre of the food purchase contacts of an area. Depending upon the population density, the reverse may well be the case.

Kelso and Jedburgh both attempt to penetrate the St. Boswells area, and therefore the point just made about returns in absolute terms refers also to their operations in this area. Neither of these centres is very industrial (Map 5) and therefore depend to a greater degree upon their central place activities for prosperity than do Galashiels or other centres of the western Borders. Further, this implies that the burghs themselves will not support hinterland-serving facilities to as great an extent as may be true elsewhere. Therefore, the expansion of routes to take advantage of hinterland markets should be expected, and the size of the food purchase contact areas would appear to bear out this expectation. Kelso extends its 23% isopleth as far as ten miles in three different directions, Jedburgh extends about eight to ten miles, while Galashiels' farthest extension is just eight miles. While some of the Kelso and Jedburgh hinterlands fall in well-populated areas, their southern extensions cross steep population gradients into upland areas with relatively few people. However, they do not meet any competition from other powerful centres to the south, and therefore, in contrast to Galashiels, are not curtailed for that reason. Thus the comparison of areas covered by these centres illustrates that area itself is no criterion of influence or dominance. More important are circumstances of population density, which measures market potential, competi-

tion from other centres, and the basis of strength from population within, as well as without, the centres themselves.

The performance of third order centres in attracting allegiance for food purchases varies widely. Innerleithen is discussed above and attention is focused here upon Melrose, Coldstream, Duns, and Eyemouth. Of these, Coldstream and Eyemouth are the least extensive in their contacts, the latter not even commanding as much as 23 per cent. allegiance, the lowest isopleth value. While this may be surprising, it is reported in Chapter II that Eyemouth is a centre whose importance is based largely upon the fishing industry and is therefore somewhat independent of a retail and service hinterland to provide the basis of its strength. By comparison, Coldingham and Chirnside, both second order centres, are very active in provisioning the countryside and extend their respective domains of food purchase contacts right to Eyemouth's "doorstep". Berwick-on-Tweed, of course, is a powerful influence in the area, and Ayton and Reston, both second order centres, are also competitors although they do not reach the level of 23 per cent. allegiance. Coldstream extends its food purchase contact area only about four miles to the 23 per cent. isopleth. This again seems somewhat surprising. It is, however, the smallest of the third order places and is caught, along lines of easy access, between the more powerful thrusts from Kelso and Berwick-on-Tweed.

To the north Duns appears to curtail any attempt by Coldstream to expand its influence. Wide-ranging in its food purchase contact area, Duns also achieves a 60 per cent. level of allegiance in two areas: the smaller part immediately surround-

ing the burgh, and the larger part in the lightly populated upland valleys above Duns to the north. In the latter area relatively few weekly contacts exist (Map 9); thus about four food purchase contacts may comprise the 60 per cent level. Other contacts are with Haddington, Gifford, and Longformacus, a first order place. Throughout the southern part of Duns' food purchase contact area the population is much denser, even approaching the density of the middle Tweed area (Map 3). In addition, the mode of agriculatural settlement is clustered, with five or six families in one row of cottages being common. This zone therefore represents an attractive one in which to sell provisions. Apart from this, it is noted that one of the major suppliers of food in Duns is a branch of the East Lothian Co-operative Society. Just as it was suggested in connection with Gullane's active servicing of a relatively wide food hinterland, it may be suggested here that the weight of the organization of such a large concern may give a centre like Duns a more energetic thrust than it would otherwise have. How much it draws on strength of this nature , first to establish and then to hold a set of food purchase contacts, is a moot question; but it may be suggested to be of some importance.

Melrose is the other third order centre with considerable influence but it is found in the densely settled middle Tweed area and lies about midway between the centre of Galashiels and the collective unit of St. Boswells and Newtown St. Boswells. Its ties with Galashiels appear to be developing very rapidly as the land between them is built up, but it is certainly not correct to assume that these

two comprise one centre, for at a local level - the level of enquiry for data for this essay - they have very distinct and separate existences. Thus Melrose is able to establish a food purchase contact area which encloses Galashiels at the 34% level of allegiance. Apart from that it may simply be noted that the 23% isopleth identifies a compactly shaped food hinterland extending some four to six miles and competing in the potentially profitable, densely settled area around it. A curious feature of Melrose's food contact area, however, is its appearance in the Ettrick Valley of Selkirkshire where the 23% isopleth is found. This is accounted for entirely by the baker van, belonging to Wallace Bakers in Melrose High Street, which calls no more often than twice a week. It is an indication of the relatively few contacts per week in this valley that two should be sufficient to reach an observable level of allegiance. Just why Melrose should be represented as strongly in the Ettrick is a question for which no evidence was gathered and therefore to which no answer may be suggested. But it may not be irrelevant to point out that, once through Selkirk and past the junction of the Yarrow and Ettrick, the author always experienced a sense of spaciousness and the "open road" which produced a concomitant urge to keep travelling and, simultaneously, a powerful sense of being <u>in</u> the valley was always present. This of course does not explain why a long linear bakery route should be established in this valley from Melrose; but given that Selkirk is only seven road miles from Melrose, this subjective field sensation renders the apparent anomaly less a surprise to the writer than it would appear from map inspection alone. It may be noted that the Yarrow valley, with similar population density and settlement

forms, and with equally easy access, has no vans reported from Melrose The only morphological difference of any magnitude is one which profoundly affects the sensation of entering the valley; it is a sensation of being enclosed because of the dark forests which stretch away from the roadside and are very much more in evidence for the first five to six miles up the Yarrow.

Second order centres appear in two general types of location: in the zones of hinterland overlap between larger centres, and in less densely populated areas. In the latter case, two characteristic locations are noted: in the lower Merse which is generally experiencing population decline and on the flanks of the Tweed Valley, both north and south of the river, roughly at 700 feet above sea level. The former includes Coldingham, Reston, Ayton, Chirnside, and Swinton of which only Coldingham and Chirnside appear in Map 10; in the latter, Greenlaw, Lauder, Morebattle, and Yetholm. The upland areas above these centres are only lightly populated. In the overlap zones, a group of second order centres are scattered through the middle Tweed region. From north to south they are Stow, Gordon, Earlston, Newtown St. Boswells, St. Boswells, Lilliesleaf, and Denholm. These last two centres illustrate particularly well the point in classical central place theory that in a zone of competition a centre of lesser significance emerges.

The food purchase contact areas of second order places appear, as would be expected from knowledge of their lesser strength, to be more

subject to pressure from other centres. In the zone of the middle Tweed, where competition is evidently very keen, the 23% isopleth for Newtown St. Boswells is displaced away from the functional centre altogether but does enclose another centre, Lilliesleaf. At the same time, Lilliesleaf's 23% isopleth is displaced entirely away from the functional centre and happens to enclose Selkirk! Denholm's 23% isopleth encloses its centre but the 34% one is displaced slightly to the south. In each case, along with centres of the same environs but of higher order, food purchase contact areas appear to be offset away from some powerful central influence, as is the case in the hinterlands surrounding Edinburgh. In this case, however, the centre appears to be St. Boswells which is one of the second order places but which is centrally located within a fairly extensive food hinterland stretching from east of Jedburgh all the way across the middle Tweed area to Galashiels. A sizable portion is enclosed within the 34% isopleth, and the impression is therefore one of a central place of considerable importance. Because St. Boswells is only a second order centre, however, clearly it may not be considered as the main influence which so affects the hinterlands of other centres. The suggestion is made here that this central importance, as it affects the hinterlands of surrounding centres, need not be a central place at all; it may also be a region of intense interaction, and probably of high population density. This would appear to describe the day-to-day manifestations of the crossroads emergence of a city; current appreciation of the importance of this area is entirely consistent with this view.(4)

Other hinterlands of second order centres conform generally to the notion that they should fill in the area of overlap and competition

between higher order centres. However, a variant on this should be pointed out where the "shot silk effect" is produced by a second order hinterland not only filling in, but also traversing and extending beyond more than one other hinterland. The clearest example of this is Chirnside whose 34% isopleth may be seen to extend from Eyemouth to Coldstream and perhaps beyond. The 23% isopleth is even more inclusive, including Coldingham in the north-east, a loop up the A1 to include Grantshouse and, bypassing Duns, loops again into the area between Greenlaw and Kelso. The overall effect is to describe a long linear hinterland running across a line connecting Berwick and Duns, and itself overlapping a number of hinterlands. These include Coldingham, Berwick, Duns, Coldstream, Kelso, and Gordon. Yetholm and Morebattle also display this effect.

While a similar observation may be made for East Linton, Gifford, Gullane and perhaps others in the Lothians, mention of the "shot silk effect" is reserved until this point because with the example of Chirnside an additional perspective is possible. On the one hand it is possible simply to say that the second order centre picks up trade in the hinterland wherever it may be found and this may extend the centre in long attenuated hinterlands. In order to explain this, however, it is necessary to account for the tendency of hinterland consumers to gravitate to the most convenient centres for their purposes. First, a point peculiar to this area in the world of central places, is that much contact with centres is through mobile shops, especially for food purchases. Hence the idea of central convenience being the cardinal attraction must be modified by considerations of ease of access and routing for vans, and the attractions by nuclei of populations which cut down their travel

as compared with a landward market which might comprise only a scattered population. With different requirements for minimum effort as among different mobile shops and as they may be compared with the aggregate centripetal tendency of a population to patronize a centre, there is no reason to presume the shape of hinterlands. The second point refers to a qualitative view of what the centre offers. In the case of Chirnside, a milk delivery accounts for much of this extension of the hinterland. Because of its perishability, milk is purchased frequently and therefore bulks importantly according to a frequency measure of contacts. But the example of milk may be generalized to read "specialized item", thus allowing the general point to be made: where there are special circumstances relating to a particular item of distribution, the shape of hinterlands may be considerably modified and the "shot silk effect" of penetrating many hinterlands may be evident. These special circumstances may include production of the item (as a diary "produces" milk at a secondary stage) as well as distribution. Where this is the case, the common distinction between secondary and tertiary activities blurs; and as central place theory is essentially a theory of tertiary activity, it may need clarification.(5) Another special circumstance may be that the "shot silk effect" may only exist in connection with lower order centres where such specialization of production and distribution would have a marked effect upon the overall behaviour of the centre and upon the spatial appearance of the centre's distribution patterns.(6)

The maps referring to food purchase contact locations contain a temporal dimension of frequency (weekly contacts and percentages of them) not found in any other maps in this work. As such, they offer perspectives and inferences not possible elsewhere. Because of this, they are treated in more detail than other maps are, but the theoretical points to be developed are left until all contact location patterns are discussed.

(ii) Contact Locations Other Than Food.

The distributions to be discussed in this section (Maps 11 through 25) are sufficiently numerous to make some grouping of them desirable in order to avoid overly-repetitious analyses. Accordingly, they are placed into groups having the most similar profiles of spatial contact intensity as observed in Figures 13-28.

Aside from Figure 13, showing food purchase contact profiles, all profiles are grouped by inspection according to their general similarity of form. This means that the most restricted average spatial distributions are discussed together and comprise the Scottish Women's Rural Institute, Primary Schools, Post Offices, and Public Houses. Following these in another group are Banks, Doctors, and Chemists which, in turn, are followed by Hardware, Petrol Purchases and Automobile Servicing, and Dentists. The last two groups include Laundry and Dry Cleaning, Purchase and/or Hire of Television Sets, Secondary Schools, and Automobile and Clothing Purchases. Clearly other groupings are possible (for example, Primary and Secondary Schools might be seen together) but it is felt that the present arrangement serves better the discussion here which analyzes the hierarchical positions of activities, their spatial extent and overlap, and the perspectives on these implied in the Level A-Level B centre distinctions, before leading into an analysis of the forms of aggregate central activity in section III(c).

Although the groupings are based on the average spatial extent and intensity of contacts, there remains an option to discuss either the profiles (Figures 14 through 28) or the distributions (Maps 11 through 25) first. The latter option is selected here because it

facilitates a more direct lead into section III(b)(iv) which is based upon an analysis of the average profiles. Therefore the implication is that, at this later stage, the profiles will be viewed with explanatory comments arising from the prior knowledge of specific distributions, rather than the distributions being commented upon in relation to the average spatial extent and intensity.

The distributions shown in the maps relate, of course, to specific items of purchase or specific, purposive contacts. As such, each distribution is systematically viewed for the study area as a whole, with relevant centres, i.e. those to which contacts are oriented, being shown. But a systematic distribution may not be taken to illustrate central place spatial interrelations in any totality; the attempt to do so is reserved until the end of the chapter (section III(c)(v)). The discussion of this section is intended to provide, by its systematic presentation and analysis of distributions, perspectives on the behaviour of these distributions in the study area; such patterns as are discussed may not easily be developed by any alternative approach.

In Chapter II(d) the functional structure of first order centres is analyzed to identify the trait complex consisting of primary school, kirk, hall, general shop and/or sub-post office. Of these functions, only primary school catchment areas and Scottish Women's Rural Institute Membership Areas can be identified with a high degree of accuracy while contact locations with sub-post offices may be identified somewhat less comprehensively (Maps 11, 12, 13). Kirk attendance information is unreliable, as explained in Chapter 1, and contact locations for food purchases in first order centres only rarely

show up in the questionnaires. Therefore, while the particular functions of the S.W.R.I., primary schools, and post offices are not confined to first order centres, their contact locations are the only ones which represent this lowest order of centres.

S.W.R.I. membership areas and primary school catchment areas contrast inasmuch as considerably more spatial overlap is evident in the former than in the latter. This difference results from the voluntary membership composition of the individual S.W.R. Institutes, a membership which an individual may retain after moving residence, in contrast to the primary school catchment areas which are officially delimited as spatially discrete units by the Local Education Authority. In both cases, however, a concern for proximity and convenience may be inferred by inspection of Maps 11 and 12 because of the large number of centres involved and the generally restricted spatial extent which contact locations define. No pattern is identified in which a few centres may be said to dominate; rather, a large number of centres have relatively similar contact location patterns, without respect for the order of the centres. Thus first order centres often seem to "outdraw" centres of higher order, outstanding examples being Old Cambus, Hermitage, and Blackness on Map 11, thus illustrating the localized distribution of first order activities, regardless of hierarchical rank.

On each of Maps 11 and 12 the dynamic nature of the distributions is implied by a centre which closed during the time of data collection. The Yarrow Institute closed during 1965 and, of its ten regular members, three intended joining St. Mary's Institute at Cappercleuch, two intended joining the Yarrowford Institute, four intended to let their membership lapse entirely, and one moved away to Innerleithen.(7) Towford Primary School was incorporated into Glen Douglas School in 1965 when the teacher moved. In the first case, the process of decline in a depopulating area is illustrated by the disbanding of a voluntary organization, with some but not complete redistribution of membership among stronger centres of activity concentration. In the latter case, another centre of minor concentration reached a level where a decision was consciously taken, by the Local Education Authority, that insufficient support was available to justify its continued existence, and it was therefore done away with.

The distributions of contact locations for Post Offices, while incomplete, reveal several characteristics. (Map 13) First, there is a notable tendency for certain larger centres to extend their reach into areas which are closer in distance and access to other smaller centres. This appears to be particularly true in the case of Level B places which characterize the less densely settled areas. During interviews the reason most frequently given for arranging for pensions and children's allowances to be administered from a Post Office in a larger, more distant centre, was that it was convenient to pick it up while in town for other purposes. This represents the operation of the multi-purpose trip principle, and carries the additional convenience that when one arrives

in town to shop, an amount of money is also to be collected. Another factor sometimes referred to was the relative accessibility of the larger centres, especially by bus on Saturdays, whereas frequently it was found inconvenient to get to a small, geographically closer, but effectively more remote sub-office, particularly in poor weather. This second point, although less frequently mentioned, represents the recognition that the impeding "friction" of distance is better seen in terms of accessibility.

To some extent the uses made of Post Offices may be regarded as first order activities, but not merely as such. For it is an activity which, evidently, more feasibly combines with others than does attendance of children at school or women at an evening meeting of "the Rural". Hence the operation of the activity may be arranged with more regard for convenience as against obligation and pleasure. A further, unmeasured, factor may influence the extent and shape of the contact locations of Post Offices. It is sometimes possible to arrange for the delivery of pensions and allowances by the postal carrier. As deliveries originate only in the larger Post Offices (Kelso, Jedburgh, etc.), a person wishing delivery must arrange for the payment of a pension or allowance at the larger office. Generally it seems understood that the postal authorities prefer not to handle items in this manner, but to deliver them to a sub-post office for subsequent pick-up. Nevertheless, direct delivery is sometimes arranged for reasons of health, age or isolation, and the contact locations of the larger centres are thus augmented.

Map 14 describes the distribution of contact locations for the use of public houses. The custom of visiting a public house is generally thought to be one of local dimensions only (visiting "the local"), but

the contact locations described in Map 14 require modification of that belief. It is true that many local, small centres are represented on this map, but is also true that larger centres display dominance. As in the case of Post Office contacts, this particular activity, a recreation, may be arranged on a convenience basis demonstrating the operation of the multi-purpose trip. A visit to the "local" represents essentially a single-purpose visit for which a conscious decision is needed and a specific effort necessary, whereas a trip to town, which may include dropping in at a public house, is activity of a more complex kind, being at once more varied because the effort to get to the public house is only part of the larger visit to town. A further factor may be the price of liquor and ale, possibly conditioning the frequency of visits to public houses; a man may decide to forgo frequent visits to the "local" in order to save towards a visit to town where he and his family or companions may choose to eat in a restaurant as well as socialize in a public house. In these ways the larger centres may come to dominate in the distribution of contact locations.(8)

Maps 15, 16, and 17 describe the contact locations for banks, doctors, and chemists, respectively. As indicated in Chapter II, first order centres generally do not support these activities, and therefore they are largely absent from these distributions; even in first order centres where such facilities as mobile or part-time bank branches are known to exist, the contact locations discovered during field work do not focus upon them except in the cases of the banks at Heriot and Oxton. The overall similarity of these three distributions is quite striking both as to the centres which focus the contact locations and as to the distributions themselves. However, there appears to be some tendency for banks to concentrate in fewer centres than either doctors or chemists,

suggesting that banks edge towards a higher order of activity. This is particularly so west of Edinburgh where settlement density is high, offering more choice of location and overall easier access for the area's inhabitants. While this suggestion may be generally valid, the greater similarity between banks and chemists, and their contrast with doctors in the Dalkeith area should be noted. Doctors are not as well represented in the Dalkeith distribution as the others, an observation parallelling the idea developed during field work that doctors are fairly locally oriented. This is most easily seen west of Edinburgh, in addition to the Dalkeith area. Both areas, however, are characterized mainly by Level A centres and by a close mesh of settlement which provides alternative locations, especially where the service is relatively personal. And there are few services considered to be as personal as those of a doctor. With this in mind, one may expect a strong pattern of overlap to express the commonly voiced experience that, after moving residence, people tended to keep up their former family doctor. However, Map 16 does not bear out such a prediction although there does appear to be a little more overlap between distributions than is evident on either of Maps 15 or 17.

The points mentioned here indicate that in general the distribution of contact points for banks, doctors and chemists are relatively similar, and the regular and restricted times for banking as against the "on call" access to a doctor in addition to surgery times would not appear to affect the spatial patterns, perhaps because of the relatively infrequent personal use of these facilities. The tendency for people to keep a family doctor for personal reasons after changing residence probably is a relatively short-term arrangement and, in time, the convenience of proximity and good reports by neighbours concerning a particular local doctor will assert themselves strongly enough to cause a change. Further,

a doctor himself may suggest, when called out in bad weather to a remote cottage, that the patient seek medical care closer to his home. The connection between medical diagnosis and the receipt of a prescription from a dispensing chemist is close functionally. Where the latter is inconveniently situated at a particular time, the doctor may and does provide both services. One would expect, however, a doctor's surgery in a centre to be complemented by a chemist in the same centre; the similarity in the distributions reflects this interrelationship.

Overall, the activities shown in these maps may be described as second and third order. According to Figure 9, banks are ubiquitously located in centres of hierarchy orders and Levels IIIB, IVA and above, and typically in IIB and IIIA and above. Doctors are found ubiquitously in IIIA, IIIB centres and above, and typically in IIA and IIB centres and above. Chemists are ubiquitously found in the same orders and Levels as doctors, but typically also in IIIA and IIIB centres and above. In this case, chemists (Category 7) show less than 50% centre representation in the second order but above that are ubiquitously represented.

The third group of distributions considered in this section are shown on Maps 18, 19 and 20 and describe contact locations with centres for the purchases of hardware, petrol, automobile servicing, and for the services of dentists respectively.

In general, hardware purchases focus upon the larger central places of the study area, with the main concentrations being on centres of third or higher order. Weaker concentrations are generally those of lower order centres. However, it is common practice for hardware to be distributed around the countryside in vans which are sometimes, but not necessarily, associated with a town retail outlet. This distribution follows generally well-defined routes with drivers calling at regular

customers; but because calls are fairly infrequent, some hawking of wares to the neighbours of customers is also characteristic. Two concentrations which are not centred upon high order places stand out clearly. These are concentrations focused upon Ancrum (second order) and Houndslow (first order). Their existence illustrates the possibility for a mobile shop to be partly or even entirely independent of a centre. The more extreme example of the two is Houndslow which is merely the place of residence of an independent merchant who sells entirely through his van and does not associate with any fixed retail firm. He makes calls on a monthly basis approximately (other vans also space their calls from four to six weeks apart) and, from field observation when overlapping with this merchant at various farms, the author would judge that he has a warm and stable business relationship with those he serves. It is interesting that, in the area served from Houndslow, there are three viable central places, Greenlaw, Gordon, and Lauder, of which only Lauder even appears on this map. Where van retail deliveries are a common practice, therefore, one may suggest the irrelevance of central place location with respect to access by large aggregates of people. What appears as more relevant are routing conveniences plus economic and convenient housing for vehicles, employees, and possible for goods storage.(9)

Although a different commodity is involved, it is useful here to point to other examples of a mobile shop distributing a "high order" good from a low order centre. The Purves shop in Allanton, near Duns, sponsors a considerable van trade in clothing and others represent shops in Newcastleton. These centres are first and second order respectively. Like hardware, clothing is non-perishable (unless fashions were to be considered) and requires no rapid turnover simply to keep the stock fresh,

It may be that the relationship between comparatively durable higher order goods and the lower order centre of distribution is direct, being the obverse of the point that perishable goods may tend to concebrate at points of high consumption, mobile shops notwithstanding.

The second point clarified by knowledge of van retailing is the degree of overlap between distributions. Responses during interviews were often to the effect that contacts with more than one centre for hardware purchases were common. Sometimes more than one van called; sometimes a van called but purchases would also be made in town, and these were indicated; occasionally all these factors were involved. Hence, on the map, lines sometimes emanate in three directions towards centres from a point of interview. Lines which cross each other sometimes indicate the operation of the routing of the vans and in addition, sometimes show different orientations for visits to town by respondents.

If overlap is obvious in the distribution of hardware purchase contact locations, it is clearly one of the major characteristics of Map 19 which shows the contacts for petrol purchases and automobile servicing. These two distributions are combined because of the difficulty in separating them in many interview responses. It is true that servicing is often done where a car was originally purchased, but this holds more for new cars than for those bought second-hand. Where it is true, however, petrol purchasing was usually reported at a different place.

Where it is not true, and in the bulk of cases this seemed to be the pattern, servicing and petrol purchasing were commonly at same centre. The long desire lines, stretching fifteen and twenty miles across the study area, usually represent second-hand car purchases made in response to advertizing in one of the weekly papers. Where a group of rays converge at one centre only, it is inferred that effort, cost of travel, and normal central orientations are factors in the convenient choice of centres.

In this group of distributions, there seems to be only a slight tendency for the greater importance of a centre, as expressed by its hierarchical position, to be parallelled by a notable concentration of contact locations. Among those which may be mentioned are Bathgate, Haddington, North Berwick, Duns, Kelso, Jedburgh, and Hawick. But the large number of lower order centres with some allegiance is also to be noted. These distributions, therefore, appear much less dependent upon hierarchical order than do others. This is entirely consistent with the appearance of Motor Trade Establishments, a Category of the Functional Classification, in the trait complexes of all third, fourth, and fifth order centres, along with second order, Level B. They may thus be said to be located without particular reference to their hierarchical position, and to command allegiance with only a moderate tendency for the highest order centres to dominate.

Dentists' contact locations, in aggregate, represent one of the most discretely arranged distributions found in the study area. Very little overlap is to be seen, the areas between Duns and Berwick,

and perhaps Tranent and Haddington, being the most notable. All the centres represented in this map are of either fourth or fifth order, with the exceptions of Currie, West Calder, South Queensferry, Duns and Lauder. The generally high order of centre involved, the extensive distributions of contact locations, the discrete spatial patterns formed, along with the relatively infrequent use of a dentists' services, are all consistent factors within established central place theory. Dental services rank as high order in this area and exert a distinctive spatial allegiance over the areas they command.

Maps 21, 22, and 23, showing the contact locations of laundries and dry cleaners, the purchase and hire of television sets and of secondary school enrollments, respectively, are the next group to be discussed. Laundries and dry cleaners fall in Category 15, Personal Services, of the Functional Classification. (See Appendix D.) While they are only examples of the several related functions which make up this Category, it may be noted that, in general terms, these facilities represent high order activity, being found in the trait complexes of third, fourth, and fifth order Level A centres, and fourth and fifth order Level B. The generally extensive areas serviced from each centre lend corroboration from a spatial distributional point of view to this claim. The most unusual aspect of the distribution of Map 21 is the disproportionate number of responses found in the area of Level B centres as against Level A. Three matters are involved here. First, a glance at Map 33, showing the laundry and dry cleaning contacts with Edinburgh, indicates the strong attraction of the city for these activities within about five miles of its boundaries, and general influence through-

out the Lothians. The discrepancy whereby Level A centres are "under-represented" as against the degree of level B activity in these distributions, especially in the Tweed, is striking and is explained in part by the operation of wide delivery and pick-up van services in the latter area. The most outstanding firm in this regard is Kelso Laundry which covers a wide area encompassing the Middle Tweed Valley, but as examples of other extensive routes, the Eildon Cleaners of both Galashiels and Coldstream (the latter having an agent in Chirnside, accounting for Chirnside's representation on the map), and the Jedforest Laundry in Jedburgh may be mentioned. The operation of these vans is of great importance in explaining this map distribution for wherever a van did not call, it was common to receive the reply that all laundry and cleaning was done personally either because a van did not call or because commercial cleaning was too expensive.

The degree of overlap between the sets of ray-diagrams appears to be considerable in the Borders, and much less in the Lothians, the two strongest "competitors" being Galashiels and Kelso which overlap each other dramatically in the Middle Tweed region. The contact locations of other centres such as Coldstream, Jedburgh, Hawick, and Selkirk do not represent serious penetrations into the areas covered by either of these centres, and they do display a tendency to avoid direct penetration in the direction of either of them. This tendency is well shown by the distributions of Selkirk, Jedburgh and Coldstream. Acknowledging this, however, it does not follow that the areas covered by Galashiels and Kelso extend to include the lesser distributions of the other centres. Thus a strong nesting tendency is not part of the distributional character of this particular activity, and the conclusion is reached that the

strength of Galashiels' and Kelso's representations is provided by the emphasis on mobile van operations.

The purchase or hiring of a television set (Map 22) involves a decision of a quite different magnitude to that involved in seeking out a laundry or dry cleaners. It should be noted, however, that certain factors limited the number of responses which were valid. First, not everybody has a television set. It is expensive to buy or represents a constant rental fee which not all are willing to pay.(10) Second, it became apparent that an element of misunderstanding was involved in the question asked if it were put in the form "Where does your T.V. come from?" The transmission point locations are well known to most people, and sometimes one of them was given in answer, for example, Ashkirk (B.B.C.) or Selkirk (I.T.A.), both on high land near Selkirk. Before this problem was understood, a few incorrect answers may have been recorded. But on examining Map 22 it is felt that the problems arising from this source of error are minimal, there being only the two transmission points mentioned in the Borders and Westerglen, Kirk of Shotts (both B.B.C.) and Black Hill (I.T.A.), all west of West Lothian. Given these factors conditioning the total number of valid responses, the distributions appear to reflect the relatively low order of this activity. Figure 9 shows that a significant percentage of IIB centres are represented in Category 5, Electrical goods and household appliances, although fewer Level A centres are. (Percentage representations are 36.7 and 14.3 respectively. See Appendix E.)

The degree of overlap among the ray-diagrams of Map 22 appears very strong in the Borders but to a much lesser extent in the Lothians. The main explanatory point here would seem to be the nature of the activity associated with the purchase of television. The reputation of

a dealer and price will both be contributing factors, but for such an expensive item a considerable amount of time will commonly be spent in comparison shopping to evaluate the merits of various possible purchases. When a decision is reached, it may not be for a purchase in the nearest centre. In such cases, the most "economic" solution may well lie in the most distant centre considered and thus produce a configuration of overlapping contacts. In the case of television, an activity which does not correspond necessarily to high hierarchical order in its distributions, but is nonetheless expensive, the seeming contradiction will result in the further apparent anomaly that areas of contact locations do not in fact nest according to a neat progression of lower order trade areas enclosed by higher order ones.(11) To say this is not to disprove the general theoretical statement that nesting characterizes central place hierarchies; it is, however, to point to an example of an exceptional activity within the central place and to indicate some reasons for its non-conformity.

The absence of overlap in the Lothians appears odd at first glance because the locational proximity of centres would suggest increased comparison buying and hence probably increased overlap. The information on Map 30 adds the perspective, and a reminder, that the Lothians are the immediate hinterland of Edinburgh, and that comparison shopping for any major purchase probably would include a trip to the City. If the distribution of contact locations for Edinburgh were superimposed upon those in Map 22, considerable overlap would be apparent immediately.

In contrast to Maps 21 and 22, each displaying considerable overlap in their distributions, Map 23, showing the specific contact

locations within secondary school catchment areas, shows very little overlap at all except where junior secondary schools nest within the catchment areas of senior secondaries, for example, Denholm and Chirnside in relation to Hawick and Duns respectively. As mentioned above in relation to primary schools, catchment areas are identified by the Education Departments in the Counties with each school having a list of residential units tributary to it. (12) Among the criteria taken into account for establishing catchment areas are: a) the existing capital investment in schools and hence their relative permanence in location. This consideration sometimes forces what appears to be an uneconomic travel pattern upon the system but is considered in the end to be cheaper. Such a consideration does not arise clearly from examining the distributions of contact locations because it often deals mainly with the fine points of boundary specification rather than with the general patterns. However, county education officials frequently referred to it as an area of concern. The point relates both to consolidation of schools and districts (Duns Secondary School serves all of Berwickshire) and to the shifts of population which affect the operational expenses of an educational system; b) the cost of transporting children in buses if they live beyond the statutory limits of two miles for those over eight years of age. Problems of the road network and of population are met in this consideration (13); c) the desires of parents for exceptions to be made are accorded individual attention. Generally this means that younger children may attend a school other than that normally designated in order that they may be in the company of older siblings. Or, some parents request that

children attend school in the larger centres in order to have the advantages of a larger school, and just the reverse also is requested by some burgh dwellers who wish for their children a "country education".(14)

With the criteria mentioned in mind, it is not surprising that variations occur in a system designed so that catchment areas of junior secondary schools nest discretely within those of higher order, i.e. senior secondary schools. (A further variation is introduced by the operation of a separate Roman Catholic school system in the Lothians). Nevertheless, a high degree of discreteness and nesting does occur when compared with other distributions, and it seems apparent that this is one of the more rigid distributions, consciously supervised from a decision level which leaves little individual choice available. Whether such conformity with the theoretical norm and with greater efficiency requires such overall conscious direction is an interesting and logical next question arising from this study.

The final group of distributions to be discussed, automobile purchases and clothing, are shown in Maps 24 and 25. These purchases share the characteristic of being made relatively infrequently (with the exception perhaps of children's clothing) and of requiring a certain amount of comparison shopping. Certainly in the case of automobile purchasing this would be true and there are several explanations involved here. If the customer is buying a new car, he will contact a dealer commissioned to market a particular line, the location being an important centre or access point; if he is buying a second hand car, the contact

location may be with a dealer who has trade-in models to sell, with a dealer handling used cars exclusively, or with an individual wishing to sell a car privately. In all cases, an important focus of comparison shopping is in the advertisements of weekly papers. These circulate widely within the study area and can have the immediate effect, discussed in relation to the purchase of television, that the most desirable purchase (probably coincident with the most economic) may involve a contact location other than the nearest central place offering cars for sale.

With such an expensive and important purchase, it is no surprise that a complex of overlaps should occur among the ray-diagrams of Map 24. Moreover, with cheap communication to potential buyers through the newspapers, the availability of an automobile for sale quickly becomes known, whether it is for sale by a firm or by an individual. Hence it seems clear that automobile selling is not necessarily a high order activity, the large number of second order centres appearing on Map 24 bearing out this point. On another tack, however, it should be noted that the business of marketing automobiles is a space-consuming one and, as such, carries high overhead costs. Some recent tendency may be noted for outlets to locate in accessible but not high order places, on the A702 at Nine Mile Burn in Midlothian, and on the A1 just north-west of Ayton in Berwickshire. While the first may be interpreted as the expanding fringe of Edinburgh (much of its turnover is with people in the city (15)), the latter installation, which is very much larger, may not be so regarded and is clearly designed to be a regional marketing point for the whole of the Merse by the British Leyland Motor Corporation. Its locational advantage on the A1 Trunk Road is accessibility to the whole of this area in the eastern Borders to a greater degree than is enjoyed by Berwick-on-Tweed,

the regional centre.(16) And whereas the multi-purpose trip principle and comparison shopping may be pointed to as important central place "builders", it must also be reiterated that the considerable importance to the buyer of this type of purchase implies that people willingly make special-purpose trips for it, and therefore destinations are determined by the special purpose.

A further factor is the scale of operation and, again as mentioned earlier, service reputation. Scale is probably increasingly important because one local effect of corporate mergers and growth on a national and international basis will be that an increasing variety of models becomes available through one corporation's dealers and this ensures that comparative shopping will be "built into" the operations of individual dealers. Thus one may shop more among the opportunities of one retailer, but will do so at the expense of the existence of others who cannot offer either the choice or the various promotional points such as warranties. (17)

A final comment here about the overlap of ray-diagrams concerns the influence of Edinburgh. Surprisingly, considering the possibilities of comparison, the city is not as dominant as might be expected. (Map 28). It is, however, when compared with Map 24, shown to dominate the area west of Edinburgh for about six miles, beyond which allegiance with Bathgate becomes strong. To the east of the City its influence is strong but not exclusive, thus increasing the pattern of overlaps in that direction, and maintaining a broad but not intense influence in the Tweed Valley. While the contacts with Edinburgh are numerous, the observation that they are not as numerous as might be expected, may be partly explained

by the practice of automobile dealers to service the products they sell (and, if busy, even to refuse service to customers who did not purchase their car from them); this could well be a factor in a decision to buy from a centre and/or dealer in a more convenient place than the city. For while careful comparison may enter into the purchase decision, servicing is required regularly and relatively frequently, usually with no "shopping" involved at all.

The distribution of contact purchase locations for clothes (Map 25) incorporates many of the explanatory points developed in reference to other distributions. First, with regard to hierarchical order, the main concentrations of contact orientations are clearly centres of high order, fourth and fifth, with selected lower order centres showing surprising strength. The strength of the lower order centres in this regard, however, usually represents the operations of a van based in the centre which calls at residences throughout the countryside. Examples of such bases include Allanton, Newcastleton, Ancrum, and Gordon. The uses made of vans varies, however, for the purchase of clothes. A few interviewees claimed they bought all their clothes from vans, while others would have nothing to do with them. Some claimed to buy work clothes from the vans but "good clothes" were bought in town. As long as they are willing to deal with the vans, however, the patterns of central orientations are bound to reflect both the personal trip to a central place and the routing decided upon by the van merchant.

Although the degree of overlap is quite considerable in this distribution, it must also be noted that part of the explanation will lie in the habit of comparison shopping, although probably to a lesser

extent than would be true for automobile purchases. Some people indicated during interviews that they visited different centres on different weeks for variety and therefore overlaps are to be expected even without comparison shopping being important.(18)

An unusual feature of the distribution of contact locations on Map 25 is the importance of centres outside the study area. Those contacts indicated are mainly accounted for by mobile shops entering the study area as part of their general routes, but the heavy concentration of contacts oriented towards Berwick-on-Tweed, and those oriented towards Newcastle-upon-Tyne, Carlisle, Glasgow and Falkirk represent visits to the centres by the interviewees. The importance of these large centres in this distribution is consistent with the heavy orientation to Edinburgh shown on Map 26. Although not pursued as a specific theme, observations regarding this distribution would suggest that when clothing is to be purchased (i.e. perhaps only when "good clothes" are being sought), the occasion is more special than when other purchases are involved and the trip and selection procedure may be considered to be a special "outing." Whatever may be involved, no other distribution displays the same degree of overlap spatially and across the hierarchical order of centres, nor do they have so many forms of direct retailing and purchasing procedures affecting the distribution. In these respects Map 25 encapsulates the processes working in all the distributions observed.

(iii) Contact Locations with Edinburgh

Although the City of Edinburgh is not studied as a specific and integral part of this investigation, its size and general importance in south-east Scotland imply that its influence inheres throughout. Moreover, even though it is not included in the analyses of functional characteristics in Chapter II, it may not be entirely avoided in this Chapter because of the frequency with which interviewees mentioned it as a contact location for some specific purpose. Already it has been necessary in the last section to refer to Edinburgh's contact location distributions; but rather than leave such an important influence in the life of the study area to incidental references, it is felt that a brief description of its influence, as expressed in contact locations, should be included as a separate unit in this analysis. This section therefore deals with the distributions depicted in Maps 26 through 37 which are, for reasons of map production purposes, arranged by extent of distribution rather than following the same activity sequence as in Maps 11 through 25. However, because of this arrangement, comment upon the distributions by comparing and contrasting them is facilitated.

A glance at Map 26, showing the large number of contact locations for clothing purchases, at first tempts the response that this illustrates an aspect of "metropolitan dominance". Berry concludes, as a result of his study of the area around Seattle, Washington, that this concept is incomplete inasmuch as it is a special case of the centralization process occurring throughout the hierarchy.(19) Berry's specific remarks are in connection with the functional characteristics of centres rather than with their contact locations outside, but the two cannot long be separated in central place

analysis and if functional shifts occur in the hierarchy of central places, then contact locations similarly should shift focus. To recall Berry's analysis serves the purpose of demonstrating that the characterization of "metropolitan dominance", merely from inspection of Map 26, should be treated cautiously; when it is also recalled that the distributions themselves each represent only a selected aspect of central activity and influence, then the idea of "total" metropolitan dominance may not be supported from the evidence of one distribution in this study. It is, however, possible to follow the logic of Berry's argument in this case and to suggest that clothing purchases are made in the city to the extent that is illustrated here for reasons of greater selection and that this represents a centralization of this specific activity within the "hierarchy"; in this case a strong tendency may be observed for the centralization to focus upon the major centre which stands in a "primate city" relationship to the study area as a whole. Support for this as a general point, as demonstrated by Berry through functional shifts, is thus provided from the standpoint of analysis of one of the complementary region's activities.

Little evidence of any important focus upon Edinburgh may be inferred from Map 27, showing contact locations for visits to public houses. This activity is identified above in section III(b)(ii) as low order, and the few contacts noted in Map 27 do nothing to dispel this.

Approximately the same comments may be made with reference to the contrasts to be noted between the strong Edinburgh influence in automobile purchasing and the lack of influence in Post Office servicing. (Maps 28 and 29). But with the distributions of contact locations for television purchases or hires, and for banking, the influence of Edinburgh recedes to the extent that only a few contacts remain with the Borders. Thus the pattern of Edinburgh's main influence being confined to the Lothians remains characteristic throughout the remainder of the distributions, although at varying degrees of intensity. Except for chemists and doctors, the area up to about five miles west of Edinburgh depends heavily upon the city; to the east, a line running north-east to south-west between North Berwick and Fala defines the limits of major dependence upon the city for the activities shown in these maps. Specific individual projections of Edinburgh's influence are important for about ten miles to the south of the city in Midlothian and Peebleshire.

Earlier, in section III(b)(ii), the distribution of contact locations with doctors is seen to be essentially a local one. Map 37 illustrates this point with reference to Edinburgh, for only thirteen interviewees claimed the city as their centre for medical treatment, and most of these lie in the commuter zone immediately to the south-west of the city in the vicinity of Balerno and Currie. To some extent the distribution of contact locations for chemists is seen, in the study area as a whole, to parallel that for doctors. While Map 35 indicates a greater concentration than this earlier comment would suggest, it nevertheless displays one of the most sparse distributions associated with Edinburgh. The functional overlap noted above, whereby doctors sometimes

dispense sufficient medicine to cope with minor ailments or to sustain the patient until he can get to a chemist is less true in the Lothians, where readier access to centres is possible. But it is doubtful that prescriptions needed immediately are the cause for a contact location with the city. Rather, the distances covered by some of the "rays" in Map 35 would suggest that the use made of Edinburgh chemists is by a family member who works in the city, or for long-term prescription needs, and for items carried relatively cheaply by chemists which, in themselves, are not the trade of an apothecary. A shop such as represented by one of the Boots chain, where photographic equipment is marketed at reasonable cost, is an example. Hence, the chemist may be characterized, like the general practitioner, as catering to a local demand, except for the few items carried which are part of the chemist's retail complex but are not the essential core of his establishment.

In regarding the distributions of contact locations with Edinburgh in an overview, it seems that explanations for them differ in degree rather than in kind from those suggested for the study area as a whole. Perhaps the most important point in this regard is that concerning comparison shopping; people making a general shopping trip to the city have the chance to compare among many shops for the various items they require, and if the purchase is a major one, the chance for comparison is clearly much greater than in a smaller central place. To this extent, the city is a place of increased opportunity, and fulfils this through the operation of the multi-purpose trip principle.

Another side of this view, however, asks <u>who</u> has this opportunity most often, and what is their association with the city? While not fully answerable in this study, the question does point up the position of

commuters in the patterns portrayed, and it may be inferred that many of the contact locations indicated describe the habits of commuters who, on lunch breaks or after work, have an opportunity to run household errands involving many of the specific items whose distributions are studied here.(20) Therefore these distributions result almost inevitably from the circumstances involving the city's position as an employer.

(iv) Profiles of Focal Activity

Section III(b)(i) analyzes distributional characteristics of food purchase hinterlands, and considerable attention is paid to the implications of temporal frequencies of contact, with Map 9 describing the frequency of weekly contact without regard to specific centres, and Map 10 describing temporal characteristics of the distribution for specific places. Subsequent sections describe spatial distributions only, and it is the purpose of this present section to advance these descriptions by identifying and interpreting the spatial extent and frequency of contacts with centres.

The method of determining the structure of the spatial frequency of contacts was to place an overlay of concentrically arranged circles, separated by an interval representing one mile, over each of the specific distributions for all centres. Next, all the contacts lying within each "distance ring" of one mile were noted and the number entered on a table showing, for each item of distribution, the number of contacts over distance. These were then averaged, by distance ring, for all centres, and then running averages of adjacent groups of three were calculated in order to smooth the profiles. (Appendix F) Values therefore describe the spatial extent and intensity of central contacts in aggregate, and imply, therefore, nothing about variations dependent upon direction. The information hence serves to answer the query, what is the general radius of hinterlands for the various hierarchical orders of centres for each specific item, and what is the intensity of interaction involved?

Figures 13 through 28 graphically illustrate the specific

results of this analysis. In each, number of contacts is measured on the ordinate axis while distance is measured along the abscissa at the same scale as used on the maps. Thus these profiles may be seen in direct relation to the distributions on the maps. The profiles relating to Level A centres are consistently placed directly above those relating to Level B. For purposes of providing a discussion parallel to that concerning spatial distributional characteristics, the groupings of profiles according to their similarity of form, as mentioned in section III(b)(ii), are maintained. The hierarchical order of centre is indicated for each profile, and the line weight is gauged to facilitate reading of the graphs. The overall shape of the profiles is generally a rise from an initial position at two miles from the centre to a peak, followed by a decline with further distance. It might be expected that the drop to the centre would not exist, but it is logical that it should be so for two reasons. First the circle at a close radius has a smaller area than that at a greater distance, and fewer interviews will potentially lie in such an area. Hence the lower number of contacts is a function of the proportion of people living in the areas of the distance rings, and the number of interviews which fell within those areas. Second, when interviewing, it seemed wasteful to insist on a large number of interviews close to the centre, sometimes virtually in the suburbs, only to receive the name of that one centre in reply to all questions. Hence the number of interviews often fell off slightly in the vicinity of strong centres.

Two further points reduce any problem which may be thought to be associated with these circumstances of profile definition. First, the

calculation of running averages reduces the minor variations involved by spreading the deviations over the profile. Thus the overall shape of the profile is generalized and, for present purposes, a better picture of the shape of profiles is presented. Second, the use of semi-log paper to plot the profiles highlights the comparative rate of change of influence over distance without such observations being dependent upon a discussion of actual values of number of contacts. Thus the number of interviews actually conducted in various distance rings is less important than simply the comparative areas of successive rings - the greater the distance from the centre, the greater potential for actual contacts up to some limit defined by ease of access to other centres in comparison. What is most important in these graphs, then, is the comparative rates of change, both within the graph as distance varies, and between graphs.

Food purchase contact profiles (Fig. 13) are much more restricted for Level A centres than for Level B, the farthest extent being sixteen miles (fourth order) as against twenty-six miles (third order) respectively. Somewhat curiously, fifth order centres, in aggregate, do not extend their contacts as far at either Level as do centres of lower order. Certainly in the case of Level B centres, third order places sometimes must extend their van distributions considerable distances in order to compensate for the lack of an assured trade based upon people's weekly visits. This would seem to be especially true of Duns, Coldstream, Melrose, and Innerleithen - the Border centres of this rank - for each of them may be conveniently by-passed for a larger centre nearby, either by bus or by motorcar. The intensity of contact frequency is similarly greater at Level B than at Level A, fourth order centres reaching an

average of nearly ten contacts at the three mile ring in the case of the former, but the greatest intensity for the latter being just over six contacts at the same distance but for fifth order centres. "Peaking" varies slightly with hierarchical order in Level B, fifth order centres "delaying" their greatest aggregate influence until the six mile ring in contrast to the peak at three miles for all other centres. This profile characteristic suggests the generally more restricted range of contacts expected of centres of comparatively lower order. It is not merely the distribution by vans which constitutes an influence here, but also the use of weekly visits for general shopping which includes some food purchasing. Second order centres do not bulk importantly at either Level, there being a distinct break on the graphs between the profiles for this order and those of higher order; this observation holds also for the profile referring to third order Level A places. As detailed in section II(c)(ii), third order Level A centres generally lie close to larger, more active places as far as central activity is concerned, and their position in Figure 13 is consistent with that discussion. Thus the food hinterlands of third order Level A centres may be said to be very weak in relation to what would be expected on the basis of their relatively high population numbers and the numbers of facilities they contain.

The next group of profiles to be discussed are those describing the distributions of four types of central contact: membership in the Women's Rural Institute, attendance in primary schools, contacts with post offices for pensions and children's allowances, and contacts with public houses. (Figures 14-17) At Level A, Women's Rural Institute membership varies in intensity directly as hierarchical order increases for the first four miles

from the centre. This applies to second, third, and fourth order centres only, fifth order having no influence in this area at all. But at Level B, second order centres display the highest intensity throughout the profile, showing a similar trend but less intensity. Fourth and fifth order centres do not maintain any contacts at all beyond three miles, and the general inversion of the pattern here demonstrates the predominantly local character of this particular social activity.

To claim that this is a "rural" activity is not sufficient to answer the paradox of this inversion, however, for all the large burghs in the study area have local Institutes, often without much outside membership, as the profiles for fourth and fifth order centres show. And even in Edinburgh several Institutes flourish. Those Institutes located in larger centres and without outside membership to speak of are, in fact, consistent with the notion of the "supremacy of localism" for the reason that they do <u>not</u> attract outside membership; as centres get smaller, they have less exclusively "urban" orientations and, for this activity, are increasingly as one with the surrounding area -- right down to the level where a first order centre, such as Old Cambus, in Berwickshire, is nothing else but a flourishing Institute in its own hall. (21)

Level A profiles for primary school contacts are virtually identical in trend with those for S.W.R. Institute membership but with a slightly greater intensity evident at two miles.
The appearance of the fifth order centres here adds to this observation, although, as in the S.W.R.I. Level B profiles, the increased hierarchical status of fifth order places automatically infers neither the greatest spatial intensity of contacts nor the greatest extent. At Level B, the intensity and extent are both much greater than at Level A in all hierarchical orders and contrast is also evident with the S.W.R.I. Level B profiles. Because attendance at school is compulsory between certain ages, all children within the appropriate age groups are involved in the profiles describing aggregate contacts. Therefore the difference in number of contacts at each distance ring is partly a function of population density, assuming that the age structure of the population is not too divergent from place to place. Another factor involved here is the complex of decisions regarding school catchment areas which are made by local officials in the light of existing capacities of schools in the main centres, capacities of smaller schools elsewhere in smaller places, the availability of teachers, and conflicts of interest as regards moves towards "efficiency" through district consolidation and school building programmes. All of these will have a bearing on catchment area decisions, thus the profiles, as the map distributions, reflect the overall state of affairs in this regard. Therefore, the general characteristics may be stated: that at two miles from a centre, an average four to six contacts

exist for primary schools and this drops so that, at 8 miles, second order places reach the minimum average recorded contacts, 0.1 per distance ring, fourth order centres drop to 0.3 contacts at eleven miles, third order centres reach 0.1 contacts at twelve miles, and fifth order centres reach further - quite erratically - as far as twenty-two miles. This last is accounted for entirely by Galashiels which has a few children in attendance from the highest reaches of the Yarrow and Ettrick Valleys; these children attend Galashiels at the request of parents and some are boarded in town during the week.

The similarity of slope between the profiles describing the S.W.R.I. contacts and the primary school contacts is somewhat surprising, considering that the former activity is voluntary whereas the latter is compulsory. However, it does appear to suggest that these activities, characteristic of first order centres as well as those of higher orders, reach a similar level of satisfactory spatial adjustment considering how far members of the Institute are willing, on average, to travel to the monthly meetings, and how far it is thought desirable for children to go to school. Both are clearly locally oriented with the main difference between them being the intensity or the number of contacts; and the greater number for primary schools is due to the non-voluntary nature of the contacts.

Profiles of post office and public house contacts also characterize spatially restricted activity. In the first, because pensions and children's allowances must be issued from a particular post office, a choice is available as to which one will be decided upon, and the pattern of contacts is thus stabilized; but little choice would seem,

in practice, to be available as to whether or not financial assistance of this sort should be accepted. (All those expressing an opinion on this simply wished the amounts received were more.) Hence there is a degree of "compulsion" about this activity set against a degree of free choice in its spatial manifestation. At Level A, the trend of the profiles appears to steepen slightly as hierarchical order increases, but the small extent reflects the greater spatial frequency of post offices in the more densely settled areas where Level A centres predominate. At Level B, profiles reach the base value of 0.1 contacts at approximately twice the distance throughout all the hierarchical orders. The intensity of second, third, and fourth order centres is very close at two and three miles, and matches that of the fifth order Level A profile. However, the drop to second order in Level B is to a position only marginally lower than that for fourth order Level A, and the third and second order positions at the latter Level are much lower yet. In addition, the trend of Level B profiles is less steep than that of Level A in general, and this, along with the intensity values noted, would seem to express the greater general allegiance to fifth order centres for this purpose at Level A, whereas third, fourth, and fifth orders are all involved at Level B. This reflects the difference in settlement density between the parts of the Lothians where Level A places dominate, as compared with that in the rest of the study area dominated, as it is, by Level B settlements. Thus larger centres at Level A are generally more easily accessible than they are at Level B, and therefore concentrate activity because smaller centres may be by-passed conveniently without adding unduly to the effort of visiting a centre. Moreover, with low

order activity, in areas of relatively less population density, low order places may assume almost as great a spatial prominence and intensity as higher order centres. This point parallels Berry's observations that, with declining population density, smaller centres assume higher order functional characteristics; the similar initial intensities of third, fourth, and fifth order centres at Level B, along with the generally lesser population density in the areas where Level B centres dominate, are thus consistent. (22)

Profiles of contacts with public houses at Level B display characteristics very similar to post office contact profiles except that second order centres are slightly more influential, third order places are less so, while fifth order centres display less intensity but the same extent. This pattern would appear to support the idea that visiting a public house is a fairly local activity in general, and is considered or perceived to be so by people responding to questions. Thus, despite the point developed in section III(b)(ii) regarding visits to public houses at the same time as a visit to a high order centre, many interviewees referred to the particular visits paid when these constituted the sole reason for a trip. Such responses serve to emphasize the importance of local places of relatively low order in this activity.

Profiles for Level A centres indicate much less intensity of influence throughout the hierarchy and much less influence spatially. Seven miles is the furthest point of contact indicated, and it is for the highest order centres, fourth and fifth. Second and third order places reach out to four and three miles respectively and no centres less than fifth order have much influence when compared with fifth order places.

The explanation here would seem to be the same as previously developed, that higher order centres at Level A are more readily accessible than those of Level B, and therefore they usurp localized activities to a greater extent than do Level B high order centres.

The next group of profiles to be discussed are those for activity associated with banking, medical treatment, and making purchases at a chemist shop. (Figures 18 -20) There is a general tendency, particularly at Level B, for these profiles to occupy higher positions in the graph than those already discussed, indicating that the influence of centres for these activities is both greater in intensity and extent. At Level A, the fourth and fifth order centres have very similar influences, reaching the base of 0.1 contacts per distance ring, usually between six and eight miles. In intensity, banks exert less influence than either of the other activities, particularly at second and third hierarchical orders. This is consistent with the trend for banks to consolidate branches in areas of population decline and so to rationalize their operations. However, it also points up the influence of the doctor as having a local emphasis, the spatial decline occurring at the three to four mile radius from a centre in the case of second and third order places. Similar intensities and extents of influence are found in the case of chemists at these low hierarchical orders, although the decline sets in somewhat closer to the central places.

Level B centres in aggregate are characterized in these

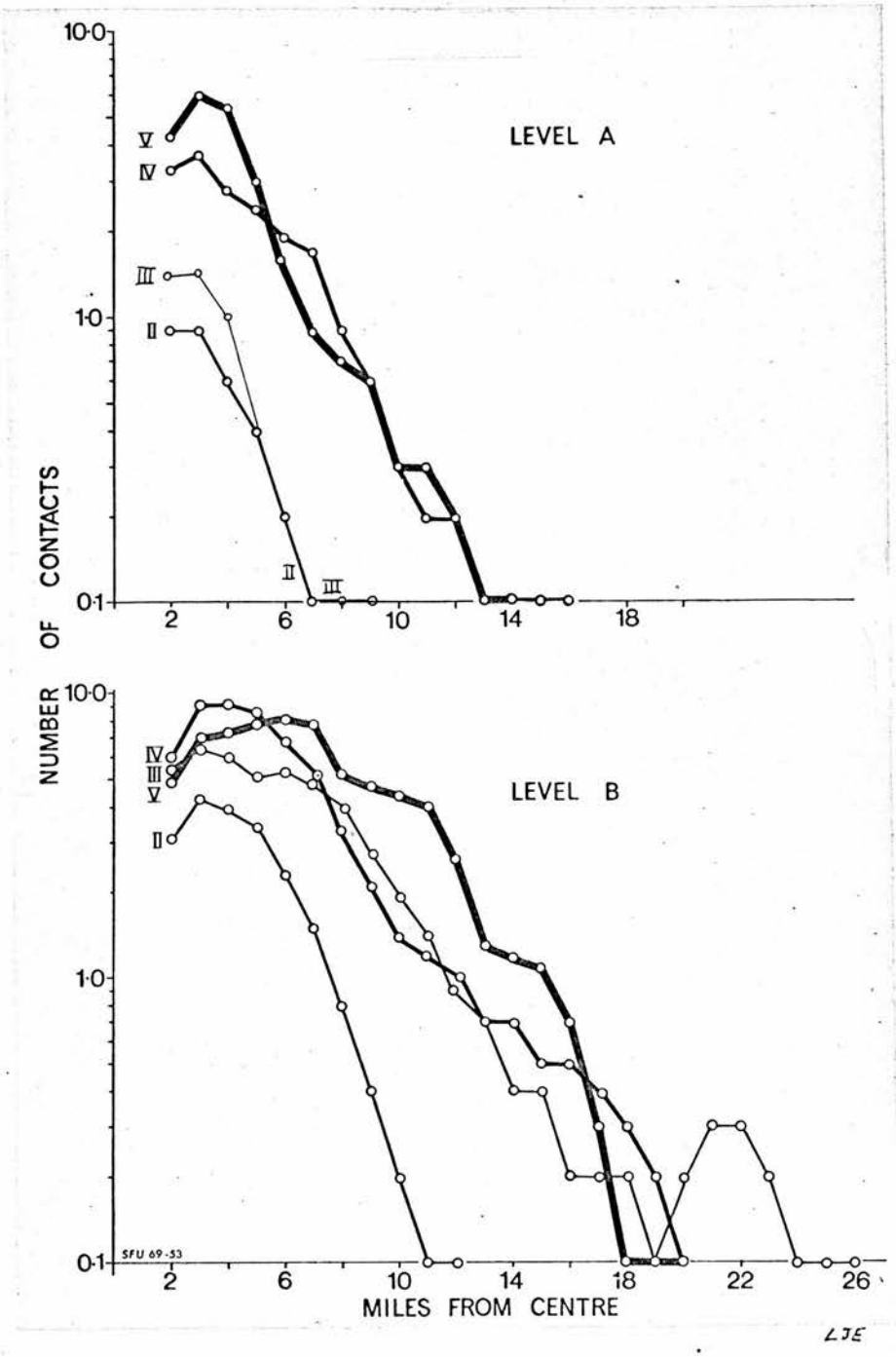


Figure 13 -- Contact Profiles: Food Purchases

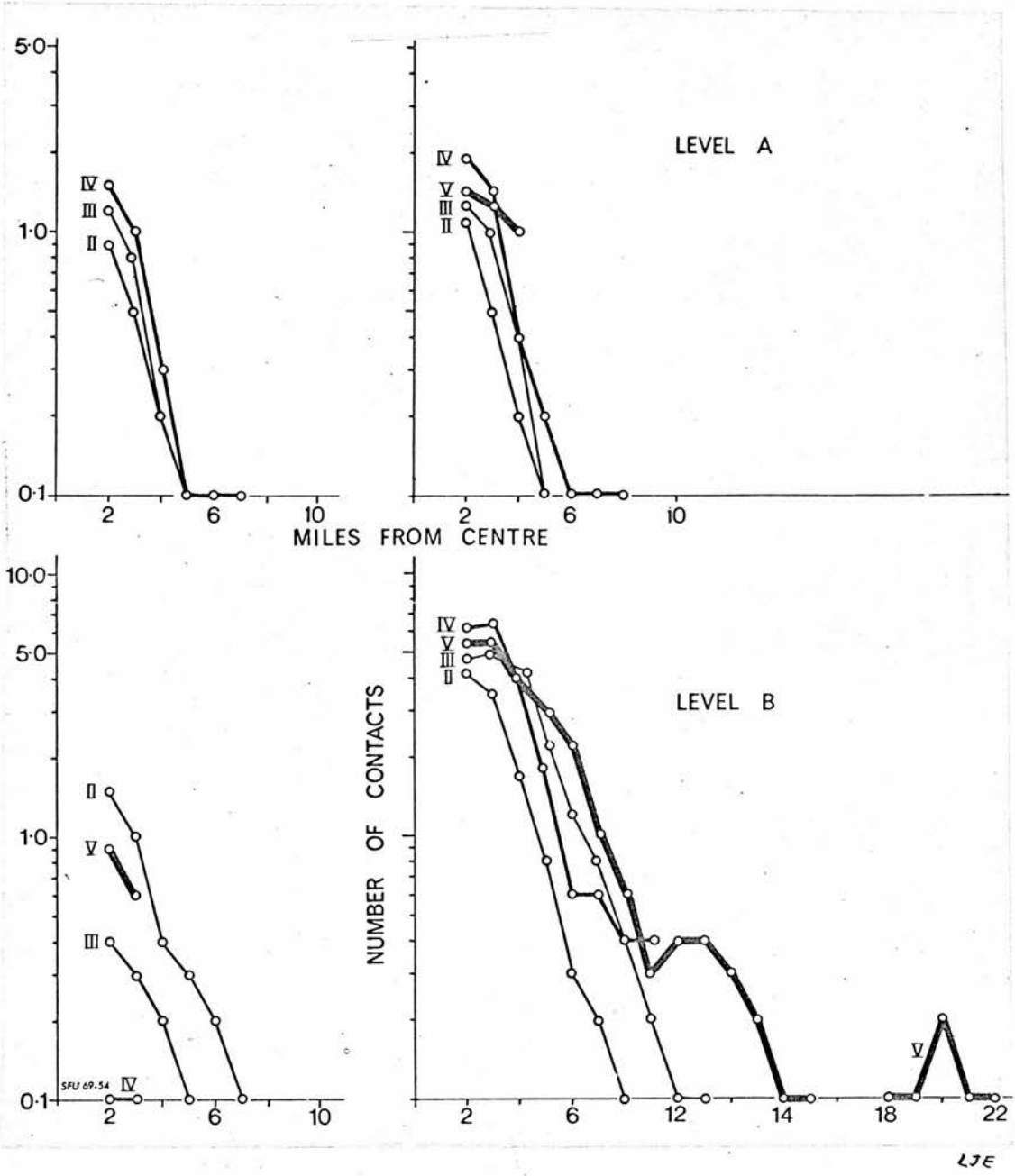


Figure 14

Figure 15

Figure 14 -- Contact Profiles: Scottish Women's Rural Institute Membership

Figure 15 -- Contact Profiles: Primary Schools Attendance

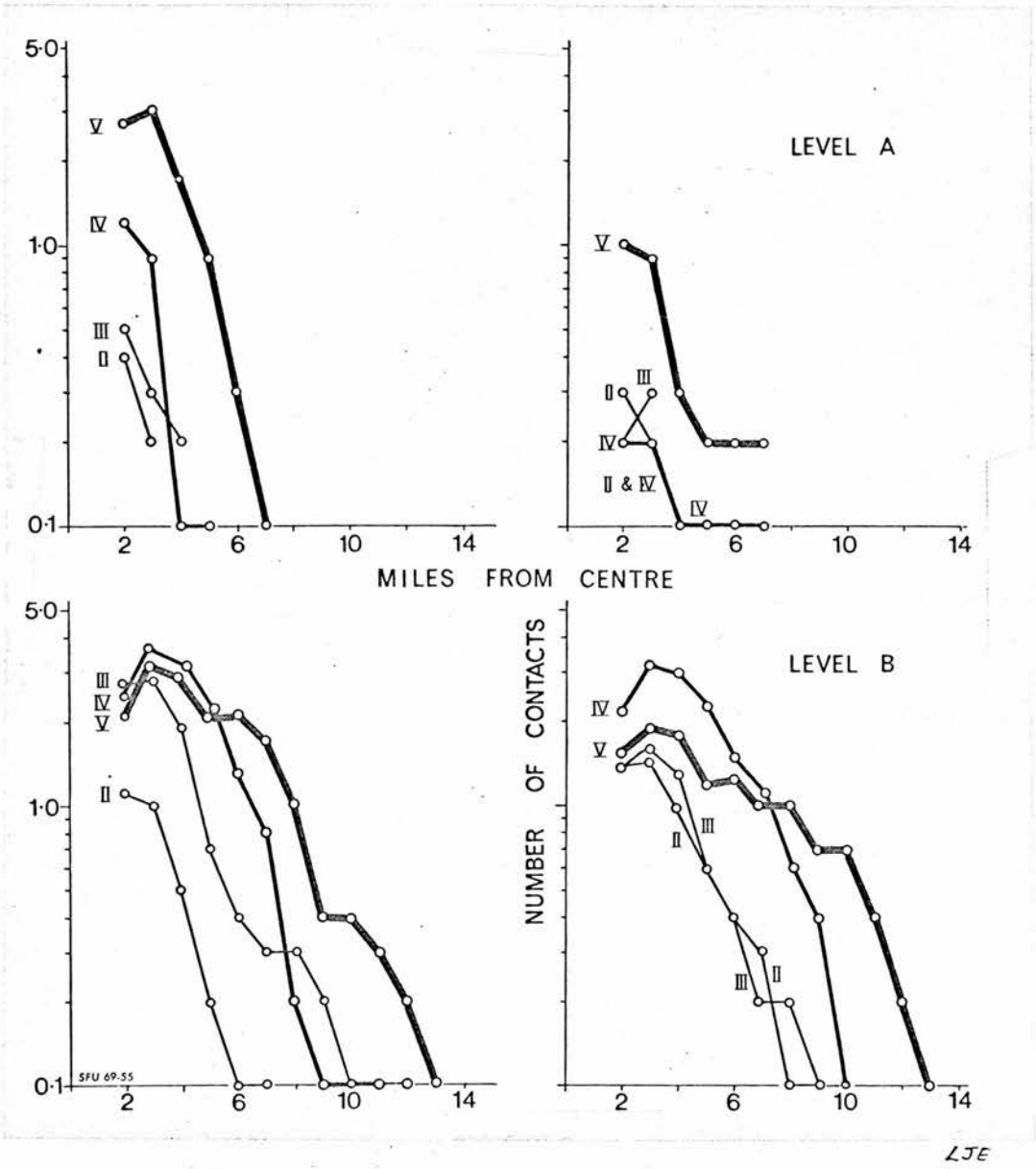


Figure 16

Figure 17

Figure 16 -- Contact Profiles: Post Offices

Figure 17 -- Contact Profiles: Public Houses

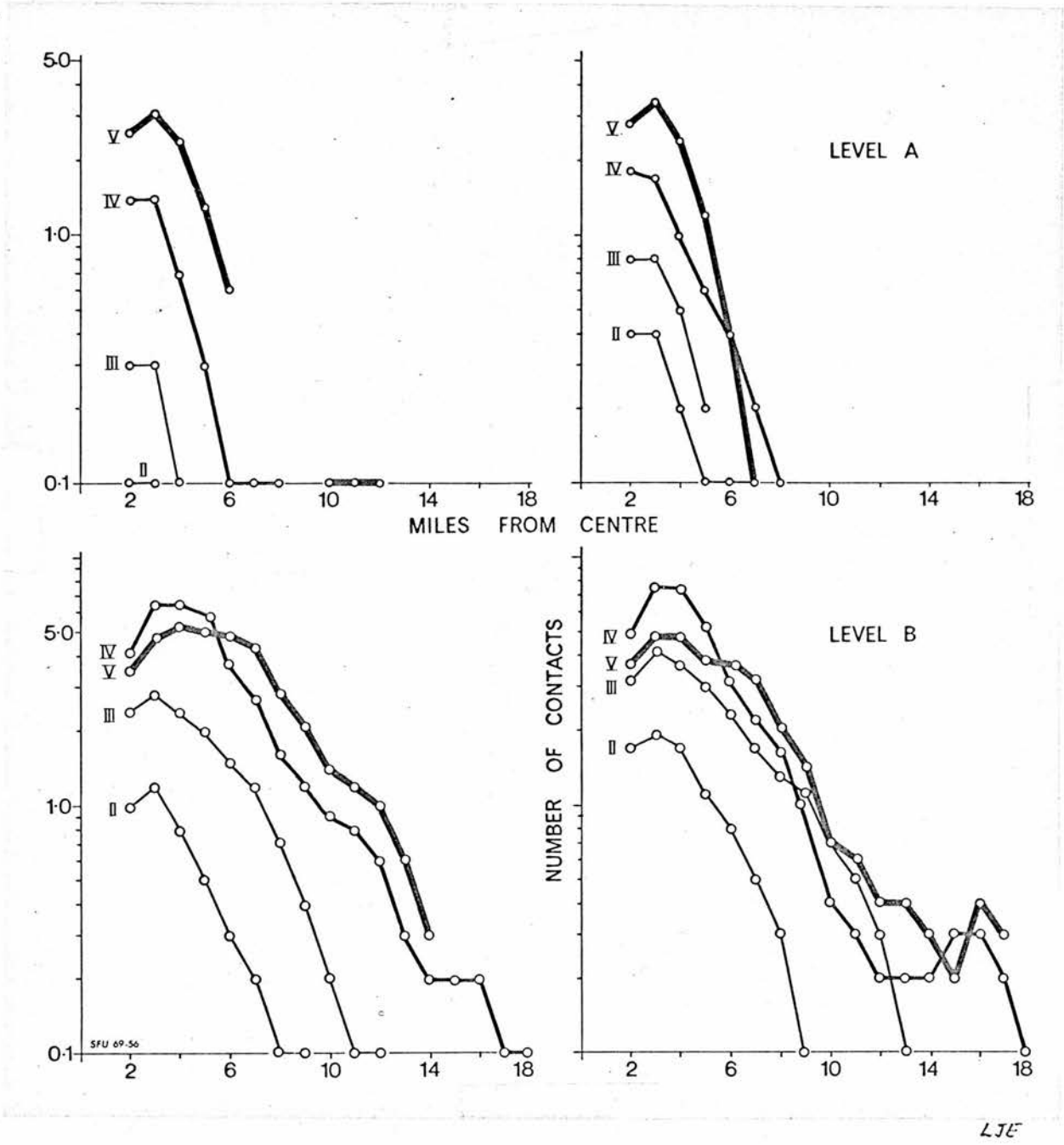


Figure 18

Figure 19

Figure 18 -- Contact Profiles: Banks

Figure 19 -- Contact Profiles: Doctors

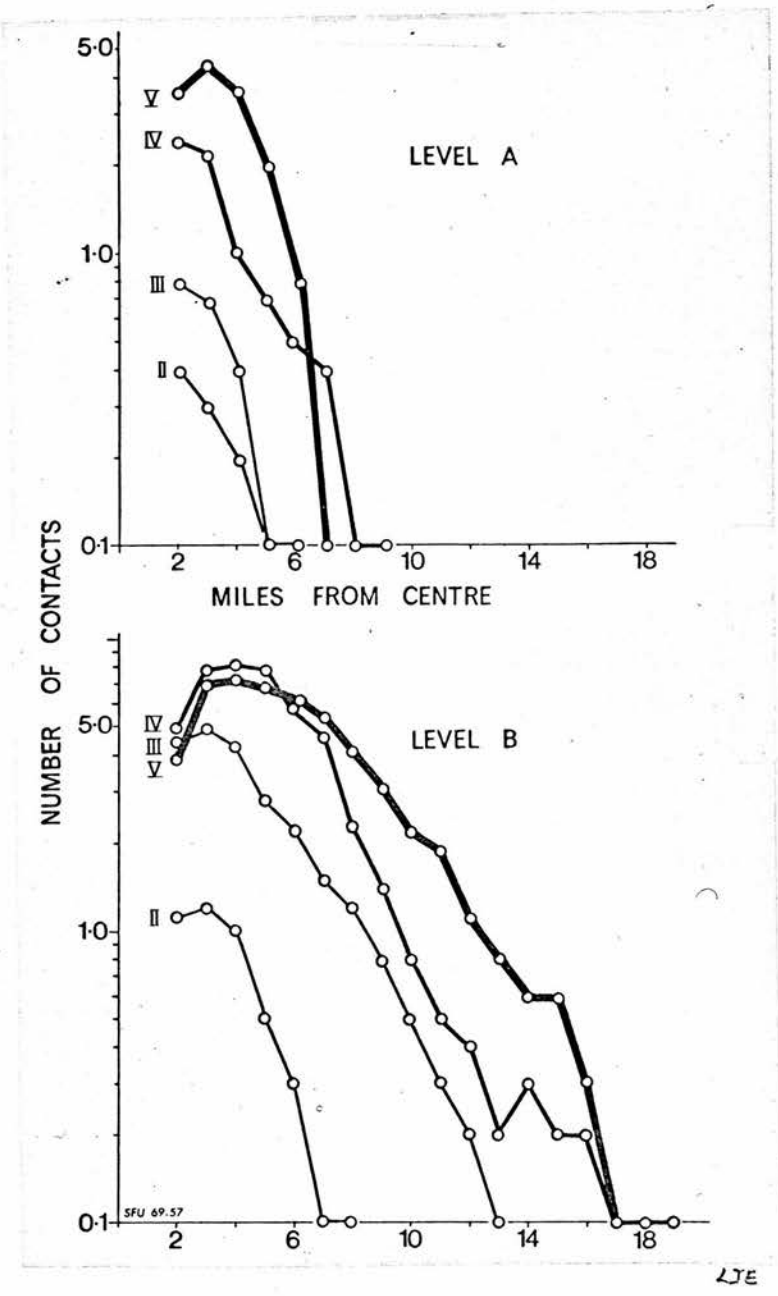


Figure 20 -- Contact Profiles: Chemists

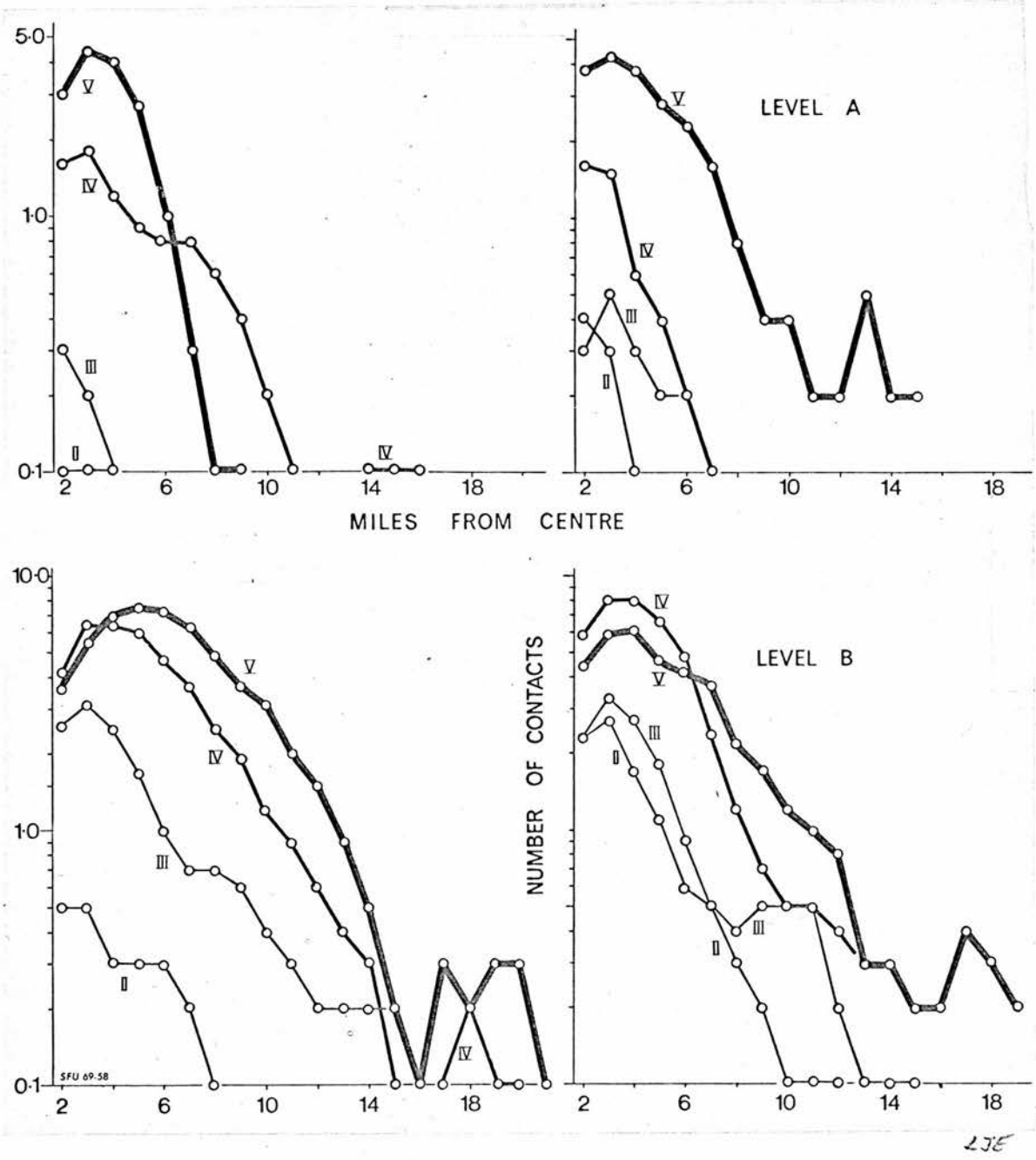
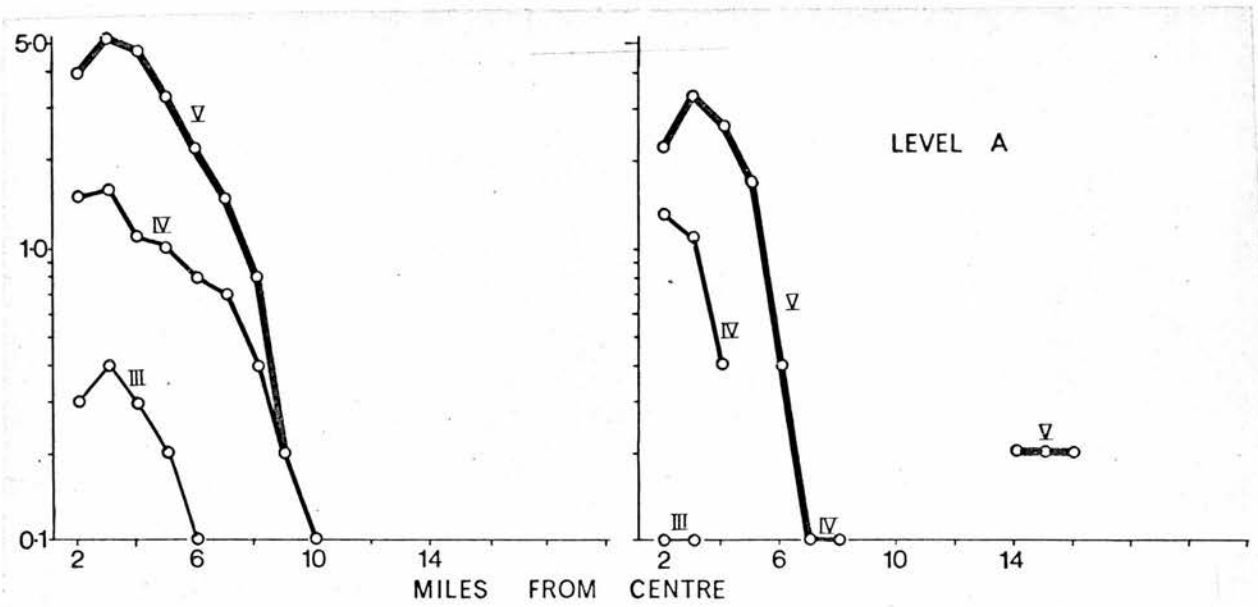


Figure 21

Figure 22

Figure 21 -- Contact Profiles: Hardware Purchases

Figure 22 -- Contact Profiles: Petrol Purchasing and Automobile Servicing



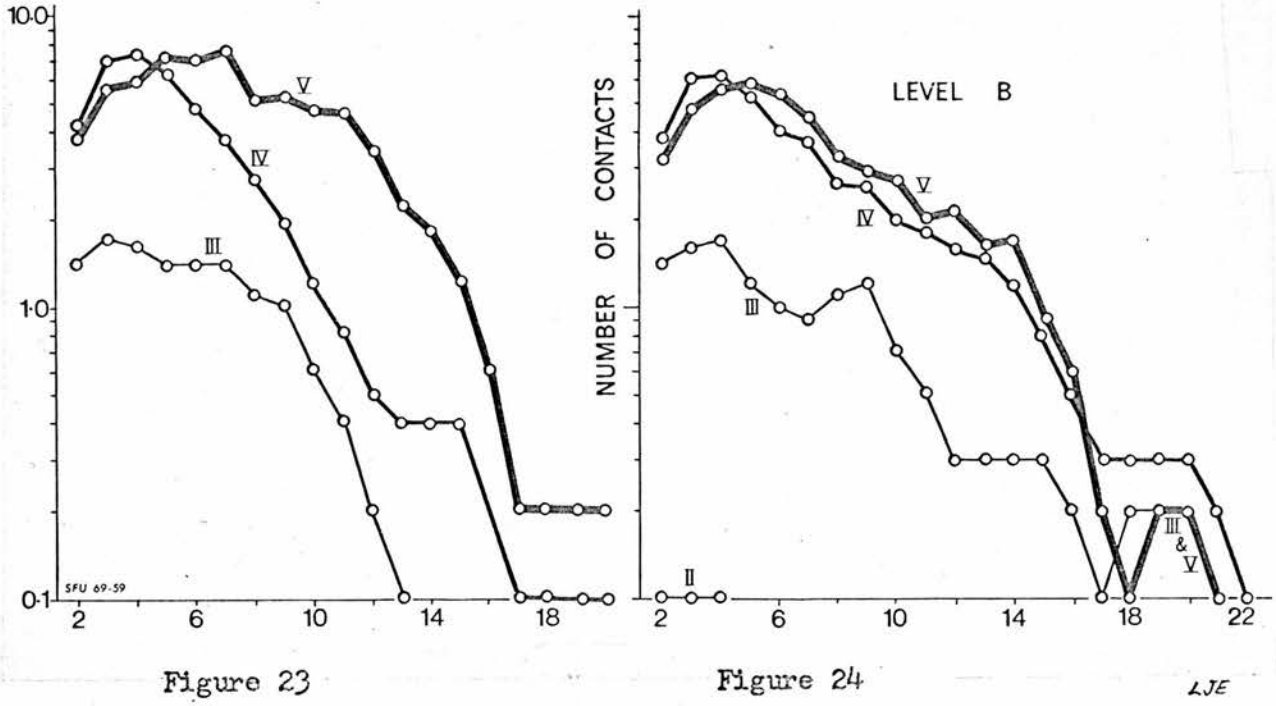


Figure 23

Figure 24

LJE

Figure 23 --- Contact Profiles: Dentists

Figure 24 --- Contact Profiles: Laundry and Dry Cleaning

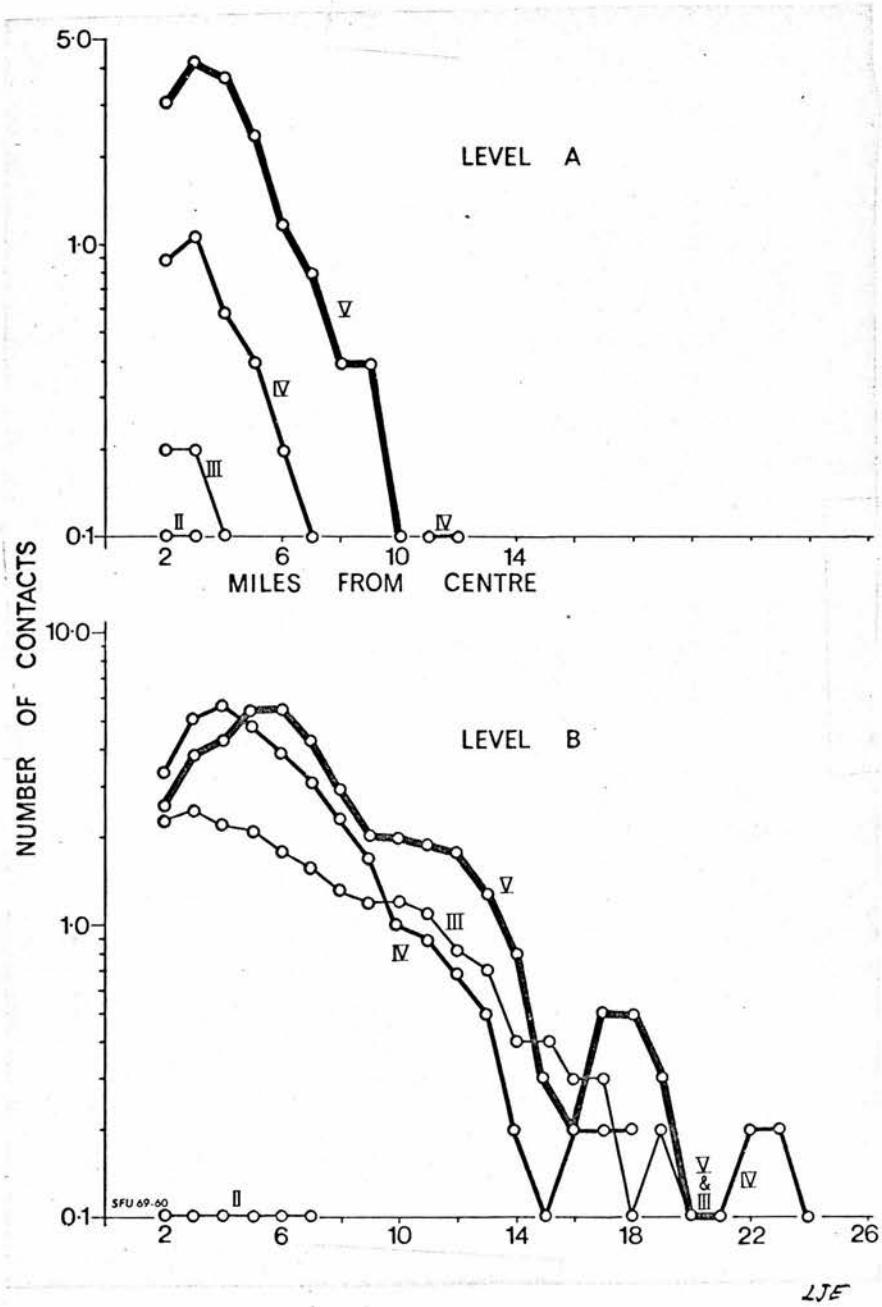


Figure 25 -- Contact Profiles: Television Hire or Purchase

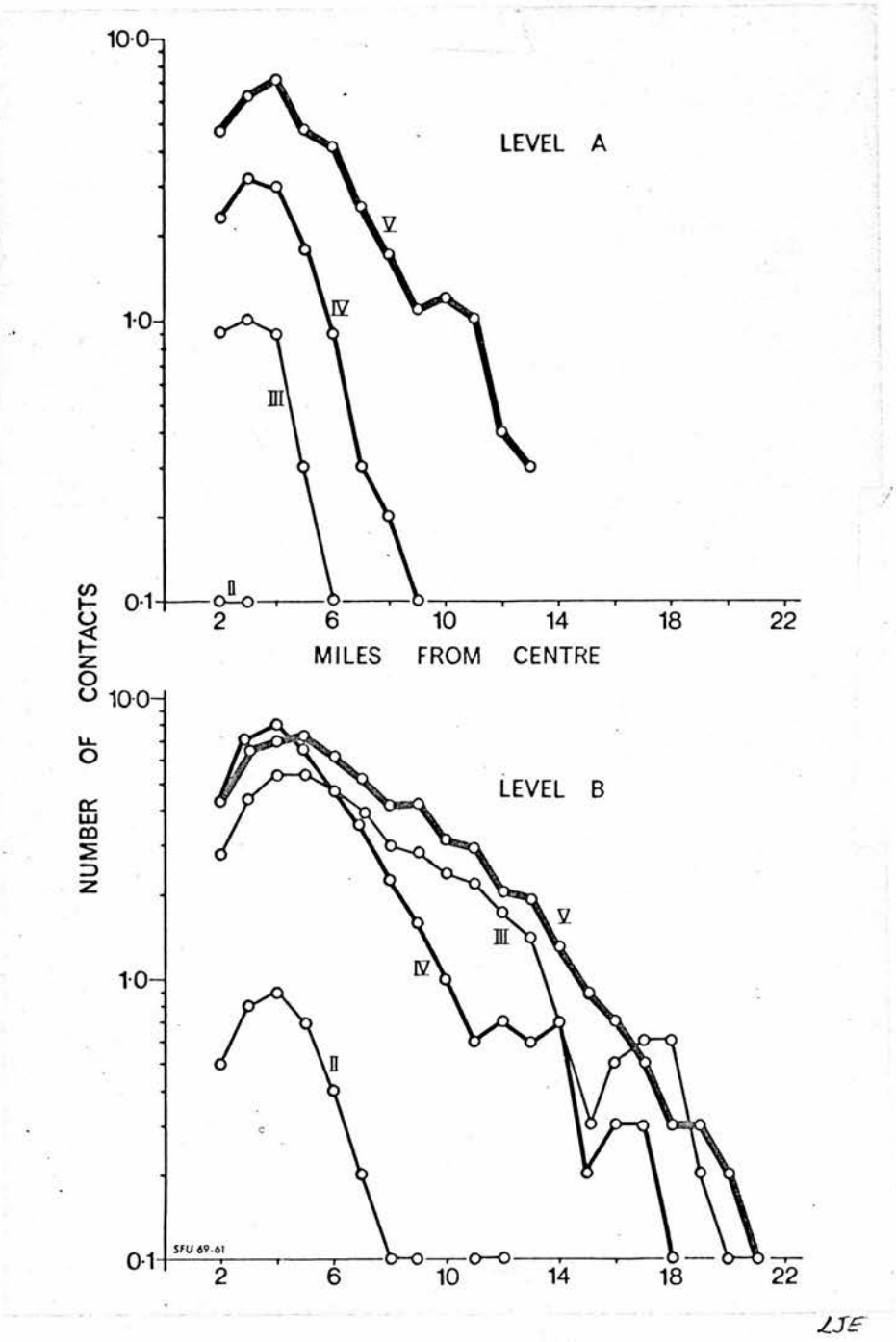


Figure 26 -- Contact Profiles: Secondary Schools Attendance

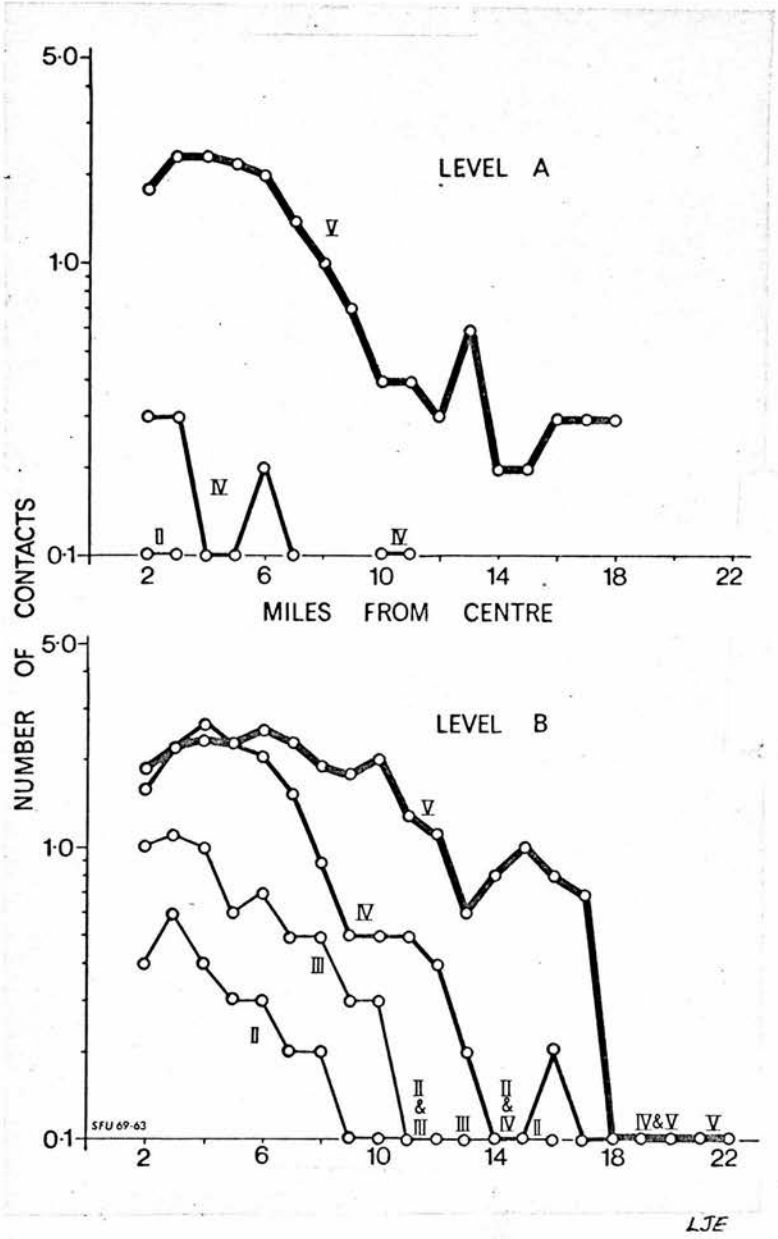


Figure 27 -- Contact Profiles: Automobile Purchases

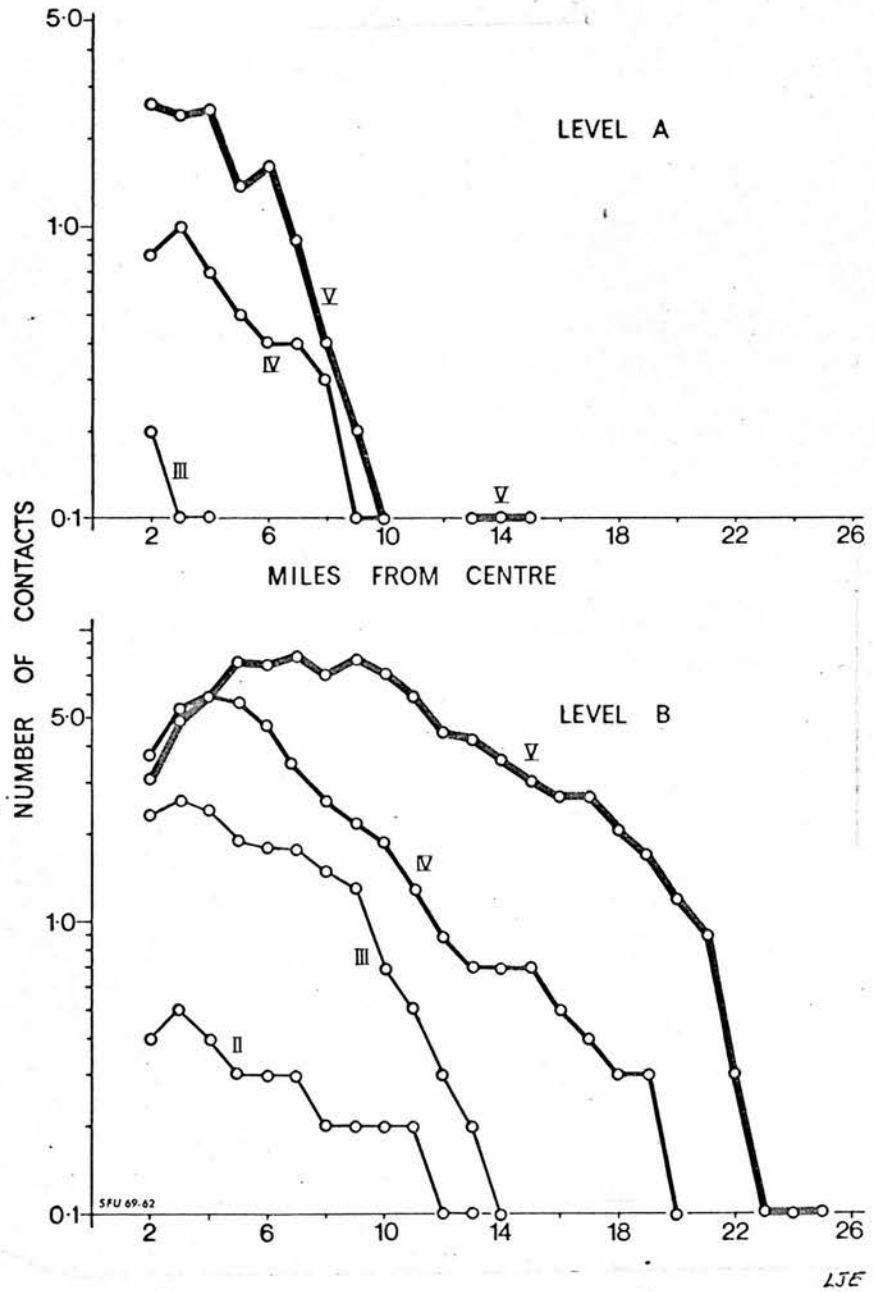


Figure 28 -- Contact Profiles: Clothing Purchases

activities by profiles which generally progress in an orderly manner, upwards in intensity and outwards in scope, with increasing hierarchical order. In intensity, second order profiles for banks and chemists are similar near to the centre, with the bank contact profile declining to 0.1 contacts at eight miles from the centre as against seven for chemists. Doctors, whose activity is regarded as more local, have a higher intensity and greater extent, reaching 0.1 contacts at nine miles. The third order profile is not as close to those of fourth and fifth order for banks as it is for doctors and chemists and, at the same time, it is observed that fifth order profiles attain a higher position relative to other orders at about five miles from the centre in the case of banks and chemists than is true for doctors. Thus, the local emphasis upon the spatial manifestations of doctors' activities is again brought out, as well as the concentration of banking activity in the higher order centres, and the tendency for larger chemist shops to attract people because they engage in considerable trade supplementary to, but not part of, the function of dispensing medicine.

The third group of profiles to be discussed here includes those describing contact locations for hardware purchasing, petrol purchasing and automobile servicing, and the practice of dentistry. (Figures 21 - 23) In general, the intensity and extent of influence of centres in regard to these activities is greater than for those previously discussed. At Level A, second and third order centres' hardware activities show minimal influence when compared with fourth or fifth order places, and second order centres at this Level have no dentists practising in them at all; thus a profile of contact locations does not appear. For petrol purchasing, and automobile servicing, fifth order centres are dominant. Their influence ——————

reaches to a fifteen mile radius, possibly reflecting the bias of dealership warranty servicing of cars, whereas the lower order centres probably reflect an emphasis upon petrol purchasing. Fourth order profiles for hardware and dentists are quite similar, reaching an extent of eleven and ten miles respectively with the additional appearance for hardware between fourteen and sixteen miles from the centre. This most distant part of the profile, however, represents only a few contacts for Tranent, and reflects the van delivery activities of the East Lothian Co-operative Society. Fifth order contacts for hardware, quite intense at the closer distances, drop off fairly sharply to the 0.1 contact level at eight miles, less than that shown for fourth order places. The drop below the fourth order profile represents the fact that two of the three fifth order centres, Musselburgh and Bo'ness, are relatively introverted functionally, therefore driving down the mean distance of focal contacts for that order. At the same time, some fourth order centres, especially in the case of an example such as Tranent, trade actively in the countryside, driving up the mean value for this order.

At Level B, some of the same characteristics as pointed out for Level A may be noted with the main difference being a widening of influence in both extent and intensity, and a tendency for the profiles of higher order centres - particularly fifth order - to bulge at about the eight to twelve mile zone, hinting as a growing relative strength of these higher order centres. This observation is more true of the hardware and dentist contacts profiles than it is of petrol purchasing and automobile servicing. As in Level A, the position of second order places

is relatively insignificant with a comparatively minor influence indicated for hardware retailing and no influence at all for dental care; for petrol purchasing and automobile servicing it is approximately the same as third order as far as seven miles from centres, after which it drops steadily away from the third order profile. (23)

A feature of this group of profiles which would appear to need explanation is the sudden increase in influence implied by the rise of some of the profiles, representing higher order centres, at their furthest distant points of contact. This is clearly seen in the hardware profiles for fourth and fifth order Level B places, in the petrol purchasing and automobile servicing profiles for fifth order Level A centres, with a tendency to it evident for third order Level B places. Perhaps the fourth order Level B profile for dentists may also be noted. Two points are important in considering these characteristics. One concerns the use of the semi-logarithmic paper for these graphs which allows not only the values to be read but also describes the rate of change. (24) Thus, where values are low, a small change may appear considerable, because it is the rate which is graphically shown. Thus, in the case of the fifth order contact profile for hardware, the fluctuations from sixteen to twenty-two miles are accounted for entirely by about five contacts made from these distances with Galashiels and Hawick. In absolute numbers, they are unimportant; but relative to the whole distribution, they are of considerable importance at such a distance. The second point concerns an implication for the growth of centres in central place theory. Godlund describes a growth pattern for central places which fills an area with centres until a saturation (of services) level is reached. If a decline in population and/or an increased ease of

access to larger places occurs, then the level of servicing from centres will be left in excess of what is needed and the smaller centres will subsequently exhibit decline as they adjust to a new level of activity. (25) The relevant points here are that access to larger centres (fifth order) is quite easy, and the countryside in most of the Borders has shown marked population decline. Thus a small number of distant contacts may herald the start of a process, or describe some stage of it, whereby the larger centres increase the spatial extent of their influence as a concomitant of population decline in the countryside.(26) A comparative study of such profiles over a period of time would, however, be necessary to test this suggested hypothesis.

The next group of profiles to be discussed is that including aggregate contacts for laundry and dry cleaning, the purchase or hire of television sets, and attendance at secondary schools. (Figures 24-26) In general, Level A centres show no greater influence, either in intensity or extent, and the trend of their profiles shows no marked change from that of the last group of profiles discussed. The exception to this is the set of profiles for secondary schools attendance which, along with food purchase contacts, is the only time a Level A profile exceeds an intensity of five contacts per distance ring. This is explained by the process whereby a centre's influence is determined "by decree" of local education authorities who "rationalize", within the constraints of what is generally thought reasonable by the public, the contact locations for schools. The effect in this group of profiles is to deepen and broaden the influence of high order centres at this Level for school attendance.

A feature common to all the group of activity profiles, at both

Levels, is the decline in the importance of contacts with second order centres. Again, only in the case of secondary schools at Level B is the exception to be found, where second order centres maintain some importance; by contrast, a profile for second order centres does not appear at all in the laundry and dry cleaning profiles for Level A.

Level B profiles generally exhibit a regular and comparable slope for these activities. Laundry and dry cleaning profiles for fourth and fifth orders are virtually identical throughout much of their length, while the third order profile exhibits a roughly similar overall trend, although more erratically traced, and shows much less intensity. This would seem to indicate that laundry and dry cleaning activity is confined in large measure to higher order centres with third order places being important where fourth and fifth do not exist in sufficiently close proximity to dominate. The examples of Duns and Coldstream are appropriate in this regard.

Although showing a somewhat wide range, profiles of third, fourth, and fifth order Level B centres for television contact profiles exhibit a similar overall trend and intertwine themselves throughout the graph. Significantly, second order places are barely represented at all, being accounted for mainly by St. Boswells, with a very few contacts also spread among Earlston, Stow, East Linton and Mid Calder. Thus this activity may be seen as relatively high order but one not demanding an emphasis upon a few large distribution centres. A similar conclusion appears to be reached at a conscious, planning stage by education authorities for secondary schools. A few junior secondaries account for the second order representation at this level; but most of the contacts, travel time for children and all other factors considered, appear to be

thought of as most appropriate when confined to the centres of third order and above. The main difference between the profiles for television contacts and secondary school attendance would appear to be that the centres of the three highest orders for schools exert similar intensities of influence in the areas lying at shorter radii (eight to ten miles) than do the television contacts, but the reverse is true for the next five miles or so, up to fourteen miles from the centre. In the case of schools, third order centres surpass in influence fourth order places after six miles from the centre. This is to be explained on the one hand by the extent of third order centres' influence in certain areas where such centres are selected as the best for secondary schools. For example, Duns in particular, but also Eyemouth, and West Calder, may be mentioned in this connection. On the other hand, when fourth order centres are found, typically the population is denser, more centres "compete" to fill the space with their services in a way analagous to the Godlund model referred to above, and fourth order places are therefore restricted **in spatial influence by the very circumstances which contribute to their relatively high hierarchical position, a high density of population.**

The final group of profiles to be considered are those representing automobile and clothing purchases. (Figures 27 and 28) In both sets of profiles at Level A, the fourth and fifth order centres are the only ones which are significant. For automobile purchases, third order centres do not appear in this activity, while second order centres occur here only by virtue of three or four contacts for each of Uphall, Aberlady, and Bilston, and single sales in half a dozen other II A centres. The important

concentration of this activity is obviously in the fifth order centres which reach out some eighteen miles in radius. Clearly, in a region of dense settlement, the amount of selection desired when purchasing an automobile is such that a considerable concentration of opportunity becomes manifest. (See also footnote 18 for this chapter.)

For clothing contacts the centres which are important are those of both fourth and fifth orders; second order centres are not represented at all in this activity, and third order ones barely are. The intensity of contacts is fairly low, however, being only about 1.0 and between 2.0 and 3.0 for the highest positions at the three mile radius. Further, the extent of influence is quite limited, effectively being within ten miles. By contrast, profiles for clothing at Level B are quite gradual in their decline with distance for higher order centres, and this is especially so of fifth order places. Although the extent of influence is quite wide, reaching from twelve miles at 0.1 contacts for second order places to twenty-three miles for fifth order places, the intensity does not reach very much higher than 5.0 except for fifth order places. This, combined with the observation that the gradients are comparatively gentle for some miles from the centre, indicates a consolidation of influence inasmuch as places may count upon shopping and occasional purchases even though other centres may also count upon this from the same individuals. Thus, these profiles may be seen as "perforated" inasmuch as quite a lot of comparison shopping may take place, therefore modifying the pattern of shopping in the "nearest" centre offering a desired commodity. Such a modified pattern is illustrated by the extreme overlapping contacts demonstrated for clothing purchases in Map 25.

Just as the general trend of profiles for clothing is seen to

describe a more gentle "distance decay" pattern than does that for other profiles discussed, so does that for automobile purchases also indicate a greater consolidation of allegiance, to some extent for all orders, but especially in fifth order centres. The intensity of fourth and fifth order places is almost identical up to six miles from the centre, but beyond that fifth order places have much greater strength to command allegiance and fourth order places experience a more rapid rate of decline in their influence with distance. Thus in both Levels A and B, for automobile purchasing, fifth order centres clearly dominate, although at Level B , profiles for second, third, and fourth orders lie in quite regular relationships with the trends being quite similar but the intensity and extent of influence varying. The explanations for the dominance of higher order centres would seem to involve those considerations mentioned earlier, the opportunity for comparison shopping for an important purchase and the trends of retailing practices.

This discussion of profiles describing the spatial frequency for aggregates of centres by hierarchical order and by specific purpose for contacts, highlights certain characteristics of activity associated with central places. First, Level A centres consistently have much less influence, both in spatial extent and frequency, than do Level B centres for the same activity. Whether the activity refers to "voluntary" visits to centres for shopping, to distributions of commodities by mobile shops following "established" routes, or to the planned organiztion of services, such as schools, the principal explanation of the distinctions between Levels would appear to be the differential frequency of opportunity for contacts as between the more densely settled areas of the Lothians and the less densely settled areas lying outside them. Second, if all profile sets are arranged according to general similarity of form, then they may be

arranged in terms of activities which are clearly very local in orientation through those which have an "intermediate" range of influence, to those which have the greatest influence. As this progression is scanned, it would appear that the activities themselves may be generally described in terms of their being of lower or higher order, and in the progression the form of the profiles may be observed to become less steep. Each of the activities studied therefore may be seen to have its own characteristic functions of "distance decay", varying with hierarchical order, but all activities may be grouped by the form of these profiles into more generalized units for discussion purposes. These profiles of specific distributions are examples of the functional arrays of central places which it is possible to study in some detail because of their suitability for data collection. Their grouping by form similarities does not parallel their grouping by functional characteristics in Chapter II, thus providing a different perspective on the varying ranges of influence which centres, through their specific activities, control. However, no individual distribution comprises a complete characterization of central place influence; therefore, settlement patterns, as related to central place activity, reflect an aggregate of individual distributions in their combined influence over the countryside population. In order to discuss the settlement hierarchy of the study area as a whole from this perspective, the following section is devoted to integrating these individual activity characteristics, whose distributions have been presented only systematically up to this point.

III(b) Footnotes.

1. Examples of the frequency of food purchasing with the smaller, second order places bear out this point. At Whitburgh Mains, just south of Pathhead, 18 out of 25 food purchase contacts (72%) are with Pathhead, the remainder being shared by Dalkeith with 3, Tranent with 3, and Port Seton with 1. One grocer alone calls five times a week,and a second calls three times. This emphasis is not surprising considering the proximity of Whitburgh Mains to Pathhead. But at Chesterhill, lying about one third of the way between Pathhead and the centre of Dalkeith, five interview schedules, when averaged, indicate a significant contact emphasis with Pathhead. It commands eight of the total 22.4 contacts, or 34.5%. Dalkeith follows with 5.6, or 24.1%, while the remainder are shared between Edinburgh (1), Tranent (2.3), Port Seton (1.5), Musselburgh (2), and Prestonpans (2). A factor in the large number of centres being represented in Chesterhill is probably its size as a potential market; this lends further import to the role played by Pathhead as the smallest centre competing there. Whitehill, located within a half mile of Dalkeith's built-up area and about three and a half miles from Pathhead, retains a surprising representation from Pathhead. Of 20.5 food purchase contacts per week (two interview schedules averaged), Pathhead accounts for 11, or 53.7%. Dalkeith follows with 6.5 contacts, Tranent with 2, and Bonnyrigg and Lasswade with 1. Considering the proximity of Whitehill to Dalkeith, this emphasis of contacts indicates there is no immediate reason to deny the postulate of the extra effort being put forth by the smaller centre to compete with the larger one; and the method appears to be the simple one of calling more often - or working harder - to achieve that goal.

2. While this point may not be as obvious in this area as at Chesterhill which lies in close proximity to numerous centres, all the centres in the immediate vicinity are represented in the interview records. For example Hardiesmill Place (between Gordon and Nenthorn) is called on nine times per week from Gordon (60%), three times weekly from Kelso (20%), twice from Greenlaw (13.3%) and once from Earlston (6.7%). Rumbletonlaw, (between Gordon and Greenlaw) receives six calls from Gordon (33.3%), four from Duns (22.2%), three from Greenlaw (16.7%) and two each from Gavinton and Berwick (11.1% each).

3. Information supplied by Mr. D. Sydserf, Transport Manager, East Lothian Co-operative Society, Tranent, September 4, 1964.

III(b) Footnotes.

4. See Scottish Development Department, The Central Borders: A Plan for Expansion in 2 vols. Edinburgh, HMSO, 1968.

5. Allan Pred is particularly firm on the point that central place theory is a theory of tertiary activity. See his Behaviour and Location, Part I, Lund Studies in Geography, Series B, Human Geography, No. 27, Section 3.4.

6. The author is indebted to his colleague, Dr. Guy Steed, who confirms the problem of the distinction between secondary and tertiary activity at a micro level.

7. Personal communication dated December 8, 1965 with Mrs. W. Barrie, of Eldinhope, Yarrow, President of the Yarrow Institute until it closed at the end of the 1964-65 season.

8. Because responses to the question regarding public house contact locations were more numerous and, therefore, aggregatively more reliable in the Middle Tweed and Merse than elsewhere in the study area, the conclusion drawn is based primarily upon the patterns in these areas. See Footnote 2 in III(a) above.

9. The distribution of hardware by independent van traders perhaps represents the modern derivative of the itinerant pedlar who once circulated in the countrysides of Europe. Formerly they appear to have been a special class of trader, often en route for many weeks during the "season". For a speculative paper on this subject, see Dahl, Sven, "Travelling Pedlars in Nineteenth Century Sweden", The Scandinavian Economic History Review, Vol. 7, 1960, pp. 167-178.

10. A definite impression was gained, through numerous interviews and conversations, that the absence of television from most households on a farm usually accompanies, though is not a sufficient condition of, the appearance of a run-down place - even squalor-and with shy, unwelcoming people, often inarticulate and reticent in the face of questions from strangers.

11. No fewer than ten second order centres appear on Map 22. These are Stow, Earlston, Kirknewton, MidCalder, Pumpherston, Uphall, Kirkliston, St. Boswells, Gifford,and Ayton.

12. In practice, only Midlothian Education Department had such a list on paper when the writer sought information in 1965. But in all other Counties except West Lothian there was an Education Department official who, on looking at a standard Ordnance Survey One-Inch Map, Seventh Series, could work out the areas exactly. West Lothian, being more closely settled and having a dense mesh of public transport, does not conceive of "catchment areas" in the same way as the other Counties but rather considers the nearest public transport as the criterion for

12. (Cont'd)
designating which school a child should attend.

13. Mr. Redpath, of the Peeblesshire County Council Education Department, clearly made this point in discussion with the writer in September, 1965. For the operating year 1964-65, an approximate figure of £33,000-0-0 was mentioned as being the cost of transporting children to school. The "herring-bone" nature of the road network was identified, along with sparse population, as a major component in the excessively high unit cost in this County.

14. Examples of these last points were detailed to the writer by Mr. Baxter, Superintendent of Education, Roxburgh County Council.

15. Comment based upon opinion offered to the writer by a personal acquaintance resident in Nine Mile Burn.

16. Another factor in its location is that it represents the growth of the firm Wood & Sons, Motor Engineers, of Ayton. The new location, close to Ayton, may result from numerous unknown influences, but it would have the desirable outcome of retaining the loyalty of long-standing customers.

17. In a recent book, J.K. Galbraith argues convincingly that the technological complexity of modern industrial products, among them automobiles, is so great that much long range planning is needed before production and marketing commence. The greater the technological complexity, the more detailed and complicated are the problems of organization, and the greater the span of time needed to deal with them. A natural concomitant of this is increased control of the market to ensure the ultimate success of the product. Assuming the present system of economic organization in Western industrial countries, therefore, a company which cannot engage in the necessary research and planning and, by implication, tie up vast amounts of capital, cannot long survive. The implications which follow for locally oriented consumers, who are the market, are that their choice will be increasingly restricted as among firms truly in competition, but expanded within the scope of the "individual" corporations' products. Locationally one would thus expect the establishment of very large sales and service outlets, at convenient access points, and the demise of smaller outlets either through their growth or business termination. See Chapters I through IV in The New Industrial State, Toronto, New American Library of Canada, 1968, being an authorized reprint of the original volume published by Houghton Mifflin Company of Boston, 1967.

18. In many parts of Britain buying through "clubs" associated with mail order houses is reported to be increasingly important. While some people were encountered in this area who made clothing (and other) purchases through this arrangement, they were few and far between. To mention this alternative as a prod during interviews often produced a scoffing reaction. See Board of Trade Journal, 8 February, 1963, "Census of Distribution and other Services for 1961".

19. Berry, B.J.L., "The Impact of Expanding Metropolitan Communities upon the Central Place Hierarchy, " Annals, Amer. Assoc. of Geographers, L. 1960, pp. 112-116.

20. For details of commuting patterns as identified by Strachan, see footnote 4 in section II(e).

21. See Footnote 1 in section II(d)

22. Berry, B.J.L., Comparative Studies of Central Place Systems, Final Report, Office of Naval Research, 2121-18, Project NR 389-126, 1962.

23. West Linton, Denholm, and Gullane are all Level B second order places with dentists. But no interviewees indicated going to these centres for dental care. The dentist in Denholm also has offices in Jedburgh and Hawick, thus implicitly recognizing the greater influence of these centres in the area and the opportunity for people to combine a visit to town for dental attention with other purposes.

24. Griffin, D.W. and L.W. Bowden, "Semi-Logarithmic Graphs in Geography" Prof. Geogr. XV, Sept. 1963, pp. 19-23; and Burke, Terence, "Semi-Logarithmic Graphs in Geography: A Pertinent Addendum," Prof. Geogr. XVI, Jan. 1964, pp. 19-21.

25. Godlund, Sven, "The Function and Growth of Bus Traffic Within the Sphere of Urban Influence," Lund Studies in Geography, Ser. B, #18, 1956. See Chapter V.

26. It also might be argued that a few contacts at this distance may be considered random. A further study therefore might be conceived to test this hypothesis. If the findings were to show that the occurrence of these contacts is random, then they could be dismissed; if, however, they were found not to be random, then explanation would be necessary and such questions such as the following might be investigated: Were a van driver, "hawking" goods in an increasingly empty countryside, decide to go further afield than usual to try to increase his contacts, and should he then make a sale, can the new customer be considered a "random" contact with the centre? Or, should a member of a family obtain employment in a centre and subsequently become responsible for certain purchases in town as required in the household, then is such a contact to be treated as having a "random" occurrence? "Randomness" implies equal chance of selection; but many factors may operate to condition the selection of centres by individuals, or of landward contacts by "representatives" of centres, in these hypothetical (but not far-fetched) examples. Any enquiry concerning them would have to consider the circumstances of decision where a locational choice is consciously being made.

(c) A Morphology of Activity

To integrate the varying activity characteristics of centres, as analyzed in this study, is not to present a final characterization of the spatial ranges and forms of influence of places in the study area. The limitations of data may be recalled to include an uneven quality from activity to activity, for example, from full information as to school attendance to partial information as to public house visits; further, at the outset, data collection was limited specifically to those kinds of activities for which information seemed most reliable and forthcoming. It may be recalled further that the population interviewed was restricted to those designated as "working class", and therefore certain contributions by other groups to the functional structure and to the general influence of centres are not dealt with here. However, it is felt that the frequency of contacts with centres taken in aggregate, may be expected to reflect the dominant patterns of central place orientations in the study area. Thus, each distribution shown on Maps 10 through 37, and each profile of the spatial extent and intensity of distributions (Figures 13 through 28) describes an aggregate form of purposive activity which is considered to be dominant in terms of contact frequency. But, as explained above, no single purpose makes the "complete" centre; even first order centres are only "complete" where at least four trait complex functions may be recognized. It follows that spheres of influence which define areas of affiliation by single purposes, describe only part of the spatial influence of a central place. However, although incomplete for reasons already indicated, all the contact frequency information, when considered together here, does go some way to

characterize the "total influence" of places at the level of an individual's activity. Some degree of judgement as to the correctness of this claim may be made below where the patterns of influence and of central place locations are discussed.

The method employed to summarize the spatial extent and intensity of central place influence, with respect to the individual types of activity considered in this study, is described above in reference to the construction of activity profiles. (Section III(b)(iv)). The running averages, taken across three adjacent distance rings for each activity, are the basis of the further aggregation of data at this point. Appendix F summarizes the data by activity for all centres of similar hierarchical order and Level; the mean number of contacts in each distance ring for all activities is taken, and together they constitute the mean profile of the spatial extent and influence for centres. These profiles are summarized in Table *10* and expressed graphically in Figures *29* and *30*.

Figures *29* and *30* show the mean profiles of contact intensity with centres; they are plotted on semi-log paper in order to facilitate direct comparisons between them. Because these profiles summarize information directly with respect to distance, and only indirectly with respect to direction, distance is the main variable, with any other variables, such as population density, being felt only in the sense that they are "built-in". For example, distributions of contacts with Selkirk commonly exhibit a long attenuated form to the south-west in the valleys of Selkirkshire, but are very restricted in the direction of Galashiels, Hawick, and the Middle Tweed region to the east. This case is chosen because it is one of the more extreme where short contact

TABLE 10

MEAN CONTACT AREA PROFILES

(Data from Appendix F)

Classification of centres		Concentric Distance Zones in Miles																								
		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Level	**Order**																										
A	V	43.9	56.3	49.1	30.6	18.1	9.9	5.9	3.7	2.8	2.1	1.3	1.5	0.9	0.8	0.6	0.3	0.3									
	IV	23.9	24.4	14.3	9.8	6.5	5.3	3.0	1.9	1.0	0.7	0.4	0.1	0.2	0.2	0.2			0.1	0.1	0.1						
	III	8.8	8.2	5.1	2.0	0.7	0.2	0.1	0.1																		
	II	5.3	4.0	2.0	0.9	0.4	0.1	0.1		0.1																	
B	V	56.8	73.2	76.3	76.1	73.5	66.3	49.3	41.8	35.9	29.8	23.9	17.2	13.5	9.9	6.8	6.0	4.1	3.6	2.6	1.7	0.6	0.2	0.1	0.1		
	IV	59.3	89.3	90.3	75.5	54.6	41.8	27.1	19.5	12.9	10.1	8.0	6.1	5.0	3.6	3.1	2.4	2.5	1.5	1.1	0.7	0.5	0.5	0.2	0.1		
	III	41.0	47.3	42.8	32.2	26.0	21.2	17.5	14.6	10.2	6.9	5.4	3.7	2.2	1.8	1.4	1.2	1.0	0.7	0.4	0.5	0.4	0.5	0.2	0.1	0.1	0.1
	II	19.6	21.1	15.3	10.5	6.6	4.0	2.4	1.5	0.8	0.8	0.6	0.5	0.3	0.2	0.2	0.1	0.1	0.1		0.1	0.1	0.1				
	I	3.4	2.3	1.1	0.1	0.3	0.2	0.1	0.1																		

Note: Means which do not attain a value of 0.1 are excluded here.

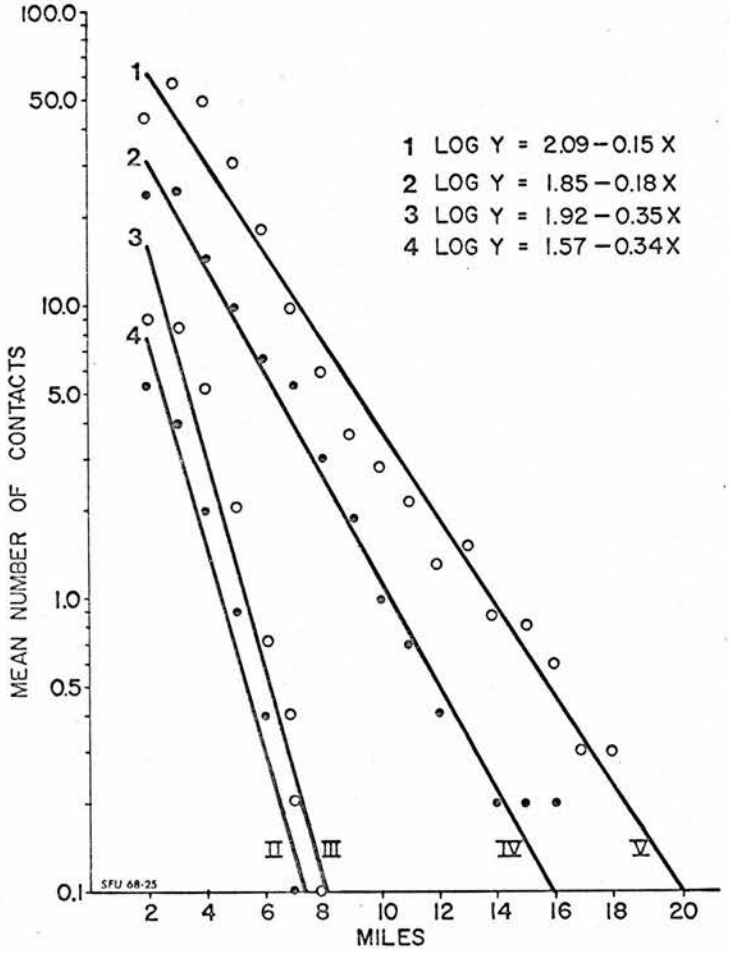
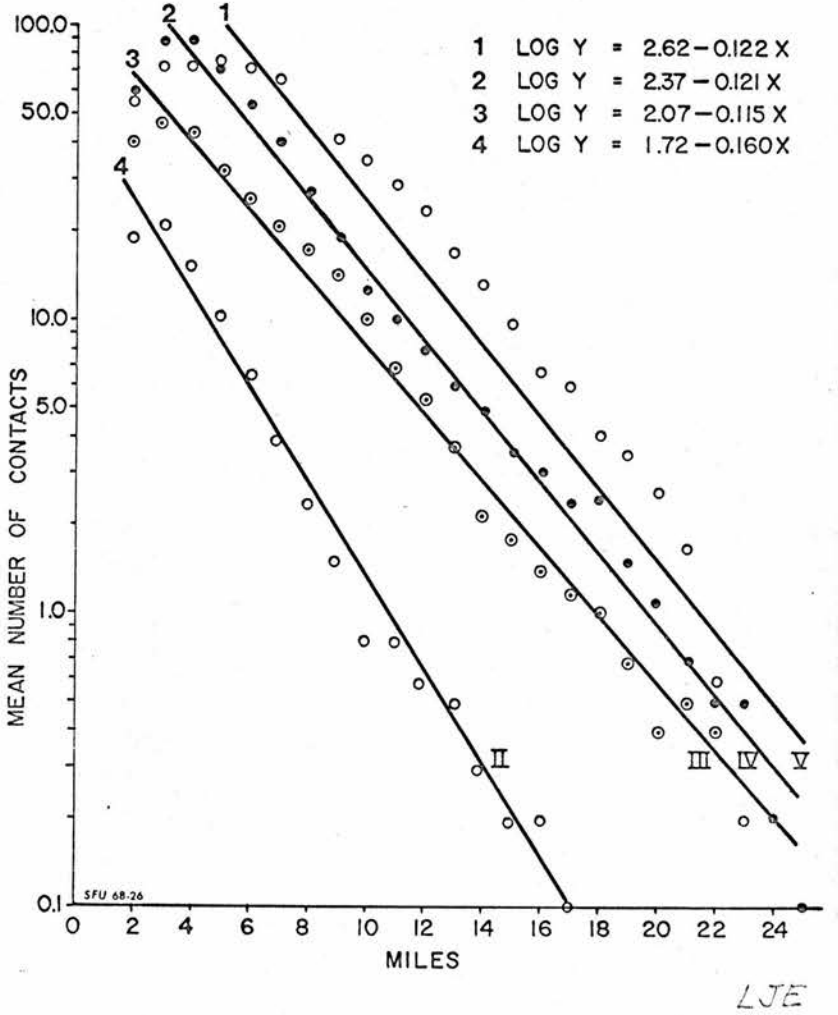


Figure 29 -- Mean Profiles of Contact Intensity with Distance: Level A Centres



LJE

Figure 30 -- Mean Profiles of Contact Intensity with Distance: Level B Centres

distances in some directions are counterbalanced by quite long contact distances in other directions, providing an example where the mean expresses the total pattern less effectively because the range is wide. However, when all fourth order centres are taken together and the mean profile is calculated across them, the importance of such an example as Selkirk diminishes within the general picture of fourth order centres in the area. In order to highlight the patterns of these profiles for comparative purposes, regressions are shown for each. The pattern of profiles which thus emerges indicates a progression of contact intensity and extent, from lesser to greater, in accordance with hierarchical order both at Level A and Level B. The sharp drop between points plotted at three and two miles in the higher order cases is due to the smaller size of distance ring close to the centre, as explained in section III(b)(iv) above. The regression line, however, is a description of the trend of the data as a whole.

It is apparent that Level A centres of second and third order do not command extensive associations in space, for the level of one contact per distance ring is reached at just less than five miles and just more than five miles respectively. (Figure 29). Their profiles are expressed in the regression equations log Y=1.57 - 0.34X for second order centres, and log Y=1.92-0.35X for third order places. Fourth and fifth order places command more extensive affiliations, not reaching one contact until just beyond ten and just before fifteen miles radius respectively. The profile for fourth order places is described by the equation log Y=1.85-0.18X and that for fifth order by log Y=2.09-0.15X.

Above the third order, each successively higher profile extends its spatial affiliations at a faster rate than it deepens the intensity of its influence, indicating a less steep profile, but a more pervasive presence, as hierarchical order increases. The most notable difference is between third and fourth order centres, a difference consistent with earlier observations as to their comparative functional structures and spatial influence as indicated by the systematic distributions of contacts.

Level B centres command greater contact areas at each order in the hierarchy than do Level A places; for example, second order centres rank with fourth order at Level A. A large discrepancy may be seen between second and third order centres, with the profile for second order places reaching one contact at twelve miles from the centre against eighteen for third order places. The interval separating the profile for fourth order centres from that for third order, approximately one and three-quarter miles, is less than that separating second and third order profiles, while a similar amount divides the fifth order profile from the fourth at one contact intensity. Thus there is a close positioning of the mean influence of Level B centres from the third through the fifth orders in the hierarchy. Considering the differences between centres of these orders in terms of population and functional structure, it is surprising that they command contact areas which are so similar. However, their very similarity points out two circumstances. First, not all of a centre may be immediately concerned with servicing a surrounding area, although indirectly, through providing employment for example, the complementary region may be intensified by the development of a commuting zone. Therefore larger centres exist with functional structures developed to an appropriate level to service the town-dwellers plus those dependent upon the centre from outside. But the amount of effort and infrastructure,

and the number of people involved in servicing the actual demand from outside the centre may be comparable to a centre of lesser order. Second, four out of six third order Level B centres are in areas of general population decline. (Specifically, these are Innerleithen, Eyemouth, Duns, and Coldstream). In such cases, the position of a profile of contact intensity may be interpreted to represent a desperate clinging to the established contact area, and an attempt to increase the contacts by more intensified efforts. In van retailing the attempt to secure more customers may be furthered by the simple expedient of calling at more residences and, by such "hawking", to establish more regular contact; in general, the attempt is to service "new" market potential,(whether by van or by trying to attract people) some of which may have become "available" through being "released" by smaller centres in decline. Certainly Duns and Innerleithen attempt to serve many a remote cottage with van trade in food, but this can hardly prove worthwhile in the long run, given current trends.(1) This point is similar to that developed in section II(d)(ii and iii) where the process of "rationalization" of duplicated facilities is discussed as an effect of population change; it is arrived at here, however, from the point of view of the complementary region rather than the functional structure of the centre. Where similar conclusions are reached from different perspectives, they are strengthened. Thus it may be stated that: centres engaged in servicing a surrounding, complementary region, attempt to expand the spatial extent of their contact areas in circumstances of general population decline in the area. This serves to preserve the "health" of the centre in the area through added "effort" to attract contacts, "effort" which would maintain the threshold level for the function. This conclusion, inferred as a consequence of temporal implications of population change, is the same as that reached

by Berry in his 1962 study, where lower order places in areas of lesser population density have comparatively large contact areas and provide relatively high order services.(2). In addition it is consistent with central place theory which calls for centres to develop at points of overlapping tributary areas of different centres, provided sufficient demand exists, and in reverse, for centres at those points to diminish and disappear if their surrounding support should become insufficient. Particularly Godlund has demonstrated this theoretical point clearly by his graphical exposition of it.(3).

Both sets of profiles, for Levels A and B, show a tendency for the "lapse rate" to increase with lower hierarchical order. Thus in a static spatial picture, the idealized contact areas are nested and, in a changing scene, lower order centres would be the first to disappear if the area were to experience general population decline. The mean profile of the contacts with distance for first order centres is the steepest of all, being described by the equation $\log Y=1.47-0.37X$ It could be argued that this is the constant relationship of first order centres as among all centres through time, but because of the general pattern of profile steepening with lower hierarchical orders, it seems more reasonable to suggest that, with few exceptions, first order centres' contact areas are contracting under pressure of population decline. Further, on empirical grounds in this study - parish consolidation, schools consolidation, S.W.R.I. decline - this contention may be supported.

It is desirable to attempt to relate the aggregate profiles of contact intensity to the individual centres of the study area. By so doing, the position of each may be related to the picture which is developed for the aggregate and, in this way, the regularities of and

deviations among settlement locations may be isolated. In order to carry out this aim, the profiles shown in Figures 29 and 30 are applied to all centres of the appropriate Level and grade in the hierarchy. Although the lowest value of contacts per distance ring which is plotted on the profiles is 0.1, the value 10.0 is judged to be an appropriate lowest value for the application of these profiles in the spatial context of the map. To extend the mapping to values below 10.0 would be to complicate the picture unnecessarily as a result of attention to data where the frequencies of contact diminish to minor proportions and become effectively minimal. Thus all outer "boundaries" on Maps 38 through 41 represent a "contour" elevation of ten contacts, the distance from the centre to the regression line on Figures 29 and 30 at selected "contour intervals" being the radius used to describe the resultant "activity cones" of the maps. Where cones intersect on Maps 38 through 41, showing activity cones for second, third, fourth, and fifth order centres individually, the boundaries in plan are always straight lines because the cones are of equal dimensions. The result is not a simple Thiessen polygon, however, for the line of intersection has a value of ten only at its extremities, rising to some higher value at midpoint.(4) In addition to these points, and for purposes of this discussion, topographic conditions are not considered and activity cones are drawn without reference to them.

The decision to limit the lower value of contacts on the maps to ten implies that activity cones for first order centres and second order Level A places are not shown. These centres are considered of minimal importance in terms of the general organization of territory

for contacts, for their profiles indicate that they do not, on average, command a total of ten contacts within a mile radius of the centre for all purposes as studied here. Of course, this is also a function of the number of interviews conducted; but given the procedure of calculating running averages for three adjacent mile rings, and given the fact that all purposes for contacts as recorded in interviews are included and that there are 172 first order and 35 second order Level A places, it is felt that the deviations occurring from variations in the number of interviews close to centres are slight and that the relative positions of these profiles within all the profiles for the study area are correct.

Second order Level B centres display considerably more importance than those at Level A, however, reaching a contact intensity of twenty-five in the two-mile distance ring. Their distribution, as shown in Map 38, is particularly strong in the Middle Tweed region from Stow to Greenlaw to Denholm, and is also strong in south-east Berwickshire. The packing together and consequent overlapping of cones is notable in these regions, as the relatively small areas enclosed by the polygons defining the spatial limits at the point of overlap would imply. In East Lothian the degree of overlap appears to be less than in the Tweed Valley, but it is roughly equal among the five contact areas (including Pathhead). This comparability is parallelled by the locational regularity that Haddington is found almost exactly (within one half mile) at the junction of the cones for Longniddry, Gullane, East Linton, and Gifford.

In the Midlothian coal field and in West Lothian, where the overall density of population is the greatest in the whole study area,

there are relatively few second order Level B places; most belong either to Level A or to a higher order, and commonly to both. Thus the Level B second order places are not packed closely in this region and they are few in number; hence they contribute relatively little to the close mesh of settlement found there. Four isolated centres occur with either no overlap, or overlap that is virtually tangential at the contact intensity of ten per distance ring. These centres are Broughton, West Linton, Newcastleton, and Cockburnspath. All four are among the most important second order Level B centres, and tend to be the major foci for personal activity in their respective, and sparsely inhabited, areas.

Third order centres, shown with their activity cones on Map 39, are relatively few in number. Seven are Level A centres, and have the smallest contact areas of all those discussed here. At ten contacts, the radius of their areas barely exceeds two and one half miles from the centre. They are concentrated in the area around Edinburgh along with Fauldhouse and Blackburn in south-west West Lothian. Level B centres display much greater importance as may be inferred from the intensity of contact as well as the spatial reach of their influence. From Innerleithen to Eyemouth they maintain wide contact areas. West Calder is an important member of this group and successfully maintains a large area west of Edinburgh within its compass. The degree of overlap at the same frequency of contact is less for third order centres than for second order Level B places because they are generally more widely spaced. However, because of the discrepancies between activity cones for Level A and B centres, two Level A places, Blackburn and Fauldhouse, lie nested within the cone of a Level B centre, West Calder. The heavy lines on the map indicate the surface intersection of the cones, where those of Level A protrude

through West Calder's cone.

The group of fourth order centres of both A and B Levels, collectively cover more of the study area with their activity cones, and together probably organize more activity, than any other group of centres in the hierarchy. Level A centres cluster tightly about Edinburgh to the east and south-east, blanketing the Midlothian coal basin, and three, Broxburn, Armadale, and Whitburn, are found in West Lothian. The degree of overlap among these centres is considerable, and they pack the area east and south-east of Edinburgh very tightly.

Level B fourth order places are even more important as organizing nodes of activity, spreading their influence through much of the study area and intensifying their contact frequency to one hundred (projected on Figure 30) at a two mile radius. Their distribution covers the western and central Borders area but little of their influence is found in eastern Berwickshire where second and third order Level B centres are noted above to be important. Level B fourth order centres dominate in East Lothian, while Linlithgow is the only one west of Edinburgh. The degree of overlap between centres is considerable inasmuch as the surface contacts are found at as high an elevation as fifty both in the central Borders and between Haddington and Dunbar in East Lothian. The surface intersection is even higher, over seventy-five contacts, with North Berwick. By comparison, and despite the closer spacing, the number of contacts reached at surface intersections among Level A centres reaches fifty only between Loanhead and Bonnyrigg and Lasswade. Where activity cones of Levels A and B centres intersect, the plan shape of the line of intersection of the surfaces is curved.

Where the Level A cone is entirely nested within the Level B, yet the centres are sufficiently distant from each other that the peak of the Level A centre's cone exceeds the depth of the Level B centre's cone, the Level A cone protrudes. The shape of this protrusion varies from the round, as at Broxburn.

In the boundary zones between these centres a number of other centres are to be found, recalling some of the regularities hypothesized in classical central place theory. Although this is dealt with more fully below, it may be briefly mentioned in this context that East Linton, a second order centre, is located precisely at the junction intersections between the activity cones of Haddington, North Berwick, and Dunbar. Further, Innerleithen lies close to the cone intersection between Peebles and Selkirk, St. Boswells and Newtown St. Boswells are found at the activity cone junctions among Selkirk, Jedburgh, and Kelso, and Hawick between the lower slopes of the cones for Selkirk and Jedburgh. Thus the distribution of fourth order centres is seen to display collective strength in the functional organization of the study area, general importance along east-west axes, and regularities of spacing among themselves and with other centres.

While fourth order activity cones display a generally east-west distribution, fifth order ones lie roughly at right angles to them, having an approximately north-south distribution. Fifth order activity cones are the largest of all in this study, reaching an intensity of two hundred and fifty (projected on Figure *30*) at just about two miles from the centre. Further, the extent of the reach of the fifth order cones, of both Levels A and B, is greater than that for any other order, and despite the few centres at this hierarchical order, their activity cones

collectively cover much of the most densely settled portions of the study area. (The diameter of a Level B cone at the contact value ten is twenty-six miles). The cones for Dalkeith and Galashiels intersect along the line of the Moorfoot Hills, while those for Galashiels and Hawick meet along a line which runs very close to the site of Selkirk. Thus a reminder of the influence of topography on the settlement structure is brought out, along with a point concerning the locational relationships among central places where a lesser place may thrive at the point of overlap between existing activity cones.

Although the picture of activity cones for each successive order of centre provides insights into the structure of the spatial order of activity, the views are incomplete because each is seen separately rather than in relation to the whole settlement system. Map 42 shows activity cones placed in their proper locational inter-relationships, with the limitation that second order centres are not included because their large number and relatively shallow depth describing contact intensity would make the map excessively complex. Thus the discussion concerns the distributional relationships of activity cones for centres of third order and higher and the three dimensional view which results is thought of as a morphology of activity.

The mechanics of constructing this map involve several relevant points. Because the map would become unintelligible if too many lines were to be included, other restrictions, in addition to the elimination of second order activity cones, are imposed. The surface "topography" is therefore shown by a reduced number of contours as compared with the activity cones shown for only one order of centre on the previous

maps. Thus, a contour is drawn only at intervals of fifty contacts. Where cones intersect, the line of intersection forms the principal boundary between areas of allegiance to centres, but as the degree of overlap on the systematic distributions shows, the influence of a centre extends beyond such a simple division of territory; further, because the depth of the cone indicates intensity of activity as measured in terms of contact frequency, all such surface intersections are the tops of "edges" rather than simply lines on the "ground", and the height of the surface intersection is a function of the location of the centres of the activity cones and the order of the central places involved. The surface intersections then are not appropriately considered to be fast boundaries, but rather the line across which activity contacts switch their dominant orientations. If the influence of a centre persists beyond this surface intersection in a less dominant or waning manner, then it is desirable that the cartographic conventions should reflect this. Therefore, below the surface of the morphology of activity, the base contour with the value ten is shown, and the lines used to show this contour and sub-surface intersections grade down in intensity as successively lower sub-surfaces are identified. Again, because of map complexity and diminishing meaning with too many minor overlaps, sub-surface characteristics are only shown to the third "layer" below the surface. It should be remarked that these sub-surface "layers" and intersections are not at a constant contact value elevation, but vary due to distances between centres and dimensions of activity cones; thus the designation of sub-surface "layers" is a function of the number of activity cone intersections only.

Virtually the whole study area is covered by the complex of activity cones of third, fourth,and fifth order centres. Only small

fringes of southern Peeblesshire, Selkirkshire and Roxburghshire, along with a small upland area of the Lammermuirs and one south of Kelso on the English border, are not included. All these areas are difficult of access, the main inhabited places lying in high constricted valleys which have experienced severe population decline. While they are served by such centres as Peebles, Innerleithen, Selkirk, Hawick, and Newcastleton, in addition to a few centres lying beyond the study area, the frequency of contact with centres is understandably low.

In the Lothians the pattern of surface slopes and contacts is dominated by Linlithgow, Bathgate, and West Calder to the west of Edinburgh, and Dalkeith, and Haddington to the east.(5) The profile drawn between X and X' runs approximately from north to south through this area but passes through and hinges at Linlithgow, Bathgate, and Blackburn. Some of the regularities of spacing among centres are illustrated by this profile. The dominant cone of Linlithgow is flanked on the north by a slight protrusion of the lesser cone of Bo'ness. To the south, the Bathgate cone stands out from the Linlithgow cone by virtue of the greater distance between them than between Bo'ness and Linlithgow. Bathgate and West Calder, VA and IIIB centres respectively, have cones approximately equal in depth, and precisely at the mid-point between them, the lesser cone of Blackburn protrudes in exact conformity with central place theory. In plan view, Blackburn may be seen to lie at and emerge through the surface intersection between Bathgate and West Calder. Other centres of lesser influence, Armadale and Whitburn, protrude through the Bathgate cone, demonstrating their strength as fourth order centres in this area.

The position of Blackburn between Bathgate and West Calder suggests the operation of central place principles of location in the area west of Edinburgh an area where the settlement patterns are somewhat complicated because of a history of mining and the locational determinants of that history. However, this essay deals not with those historical factors except as they may be an integral part of the more relevant aspects of settlement for this study - the size of population clusters and the manner of central place organization in the area for a specified sub-group of the population. Hence it is logical to expect, if central place theory has application here, that centres will be found near, or at, the surface intersections of cones as in the Blackburn example. The most obvious point of surface intersections to look for such a development is at the point where slopes from the activity cones of Linlithgow, West Calder, and Bathgate intersect. Although not achieving third hierarchical order, Livingston Station is located at almost precisely this point, and in fact, the point of intersection lies in the middle of the designated area of Livingston New Town. The latter is specifically sited with an eye to questions of land availability, and mining subsidence for example, but it is considered meaningful nevertheless that the New Town location should include the point of greatest potential, according to central place principles of growth.(6) This does not, of course, imply that the area is not well serviced from surrounding centres, but reflects the opportunity of contacts with a relatively large group of places and no clear overall dominance by any. Such a point is not necessarily borne out by an examination of systematic distributions of retail and service contacts; but in aggregate,and when the cones representing

these aggregates are located and observed in their interrelationships, the pattern emerges. Other centres, of lower orders, which may be pointed out as occurring at the location of intersections of activity cones include East Whitburn at the intersection of cones for West Calder, Bathgate, and Whitburn. Similarly, Longridge lies at the intersection of cones for Fauldhouse, Whitburn, and West Calder. Below the surface, at the intersections of cones at sub-surface levels, the same locational regularities may be observed. Bridgend, a thriving centre, owing to the construction of new Council Houses, is found at the complex of sub-surface intersections roughly equidistant between Broxburn and Linlithgow; Kirkliston is located at the point of sub-surface intersection of several cones two or three miles due south of South Queensferry; and Ratho and Ratho Station are found at the surface intersections of West Calder and Broxburn's cones (discounting Dalkeith and Linlithgow which also intersect here) and several sub-surface intersections which, in this location are probably more important than the surface itself because they represent the "local competition". These examples would seem to demonstrate that the spatial regularity of settlement, even in West Lothian, is consistent with central place theory. From this may be inferred the importance of the determinants taken into account by the theory, even in an area where difficulties in finding such consistency may be most anticipated.

Anticipated difficulties are those which are implied by several centres whose locations are not in clear conformity with what central place theory would suggest they should be. In order to examine this, Figure 31 is drawn to show the dominant centres and their cone intersections from Map 42. Superimposed upon this pattern are the other centres identified in the area west of Edinburgh, symbols being selected to indicate absolute population decline, in the decade 1951-61, population

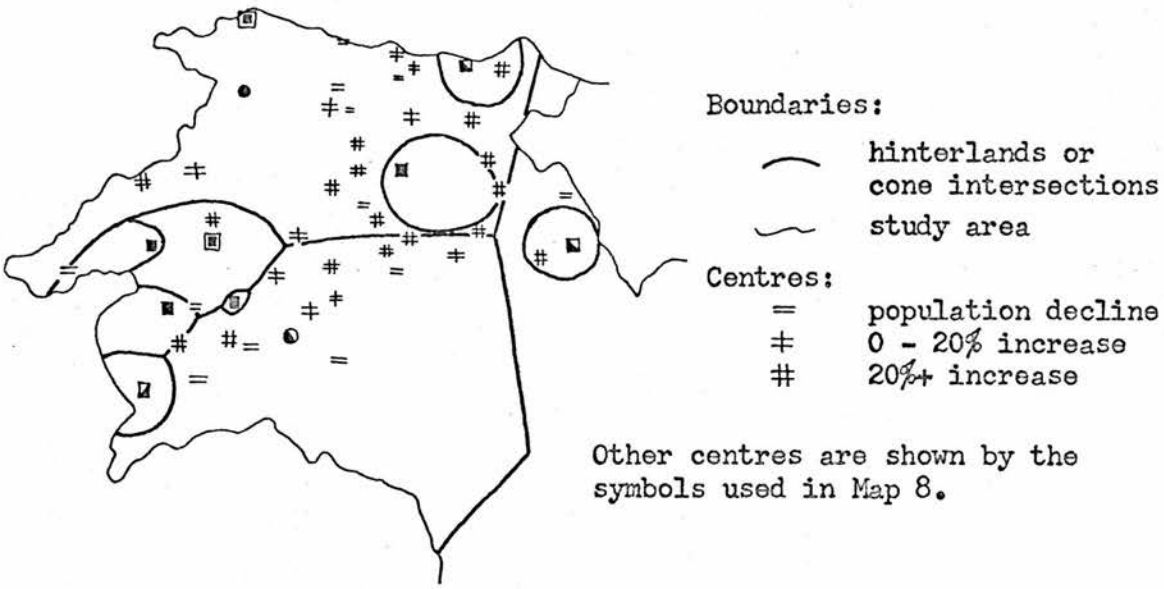


Figure 31 -- The Relationship between Activity Cone Surface Intersections and Central Place Locations in the Area West of Edinburgh.

increase between 0 and 20 per cent., and in excess of 20 per cent. The overall population change for the County of West Lothian was an increase of only 0.05 per cent. during the decade; thus the positive departures of many centres' rates of change from the County "base" indicate a considerable shift and redistribution of population into centres.

Most centres show a population increase, with decreases being confined to those on the southern fringes of settlement (in Midlothian), East Whitburn between Whitburn and Blackburn, the latter being a centre of considerable recent growth (29 per cent in the decade noted) thus perhaps drawing population from East Whitburn. Four small centres in the north also declined. Marked growth in excess of 20 per cent., however, may be observed in a "string" of centres from Dalmeny to Wilkieston, from Ecclesmachan to the Calders (Mid and East), in the second order centres Longridge and Stoneyburn, and the first order places Westfield and (by) Ballencrieff. Of these centres, those showing the greatest percentage

population increase are precisely those lying along the cone intersections between Broxburn, Linlithgow, and West Calder.(7) Other centres which have experienced population growth and which lie along or near cone intersections (i.e. hinterland boundaries) are Livingston Station, Seafield, Longridge, and Kirknewton. As already noted, East Whitburn provides an example of a declining centre between two places which are increasing in size, thus demonstrating, in population trends, the progression of central place development whereby the more powerful centres may usurp the influence of lesser places.

The places identified above do not exhaust the list of centres in the area, however, and some explanation of other central place locations is in order. In this connection, three major influences may be noted. First, Edinburgh exerts a strong pull upon the area, particularly upon those centres lying just to the west of the city where commuters comprise a high proportion of the labour force. (see Footnote 4 in section II(e)) To some extent these centres are "dormitory" to the city and may be thought of as reflecting, in their increase, the city's general growth and suburban spread. To a lesser extent this is true throughout the area shown. A second influence is that of "movement corridors". Broadly speaking, most of the centres showing population increase lie along an east-west corridor of movement whose axis is the A8 Trunk Road, implying the correlation between such movement and the growth of centres. These two influences, both related to the importance of Edinburgh, are factors of explanation of large scale circumstances. As such, they indicate tendencies in the overall growth pattern of central places in the region; but they do not predict precise locations for small centres. These may be located for reasons of local central place competition in the recent past, site conditions, or for historical reasons dating back

some considerable period of time. An example of a partly historical explanation highlights the problem of historical influence: Torphichen was established as the principal settlement in Scotland of the Knights Hospitallers of the Order of St. John of Jerusalem in the latter part of the 12th century.(8) An ancient siting of a settlement, however, does not explain contemporary growth, although it may not be incompatible with it. Thus it may be noted that Torphichen lies along a main route between Linlithgow and Bathgate, respective nodes of the movement corridor shown on Map 1; this is also the access between the largest centre of the area (Bathgate) to the administrative centre (Linlithgow) of the County. The ancient importance of this centre in the region is not matched to-day by any stretch of the imagination; yet it increased its population by 12 per cent, between 1951 and 1961, a rate well in excess of that for other centres, thus demonstrating the viability of this location to participate in the settlement hierarchy of the contemporary period. (9) An example of site control over the location of central place development is found in the case of West Calder and Polbeth. The latter represents the growth of the former, but was created as a new centre at another location because of the lack of suitable land for expansion at West Calder. (See section II(c)(i) and footnote 9)

To the east of Edinburgh, Dalkeith and Haddington stand out as the major centres of influence, their activity cones intersecting along a line from just east of Cockenzie and Port Seton to Oxton where they intersect with Galashiels' cone. The coincidence of Oxton with this intersection represents further demonstration of the operation of central place theory in the existence of a smaller centre at the point

of overlap between spheres of influence of larger centres. Another example is the location of East Linton, precisely at the point of intersection among activity cones of Haddington, North Berwick, and Dunbar.

Even a profusion of intersecting cones, however, is not a guarantee that a central place will emerge at, or close to, the point of overlap. This point is well illustrated in the case where the cones for Dalkeith, Peebles, and Galashiels intersect, with several other intersections being apparent nearby at sub-surface levels. However, apart from a few fairly isolated farms and cottages, there is no settlement of the area at all. But the point of cone intersection does lie at about the junction of the B709 running north-east from Innerleithen to Heriot, and the B707 which forks north to cross the scarp of the Moorfoots and descends to meet the A7(T) at Middleton. The roads follow the valleys of the Dewar Burn and Heriot Water,and fork at the valley junction. Thus it may be claimed that although central places may not be in evidence at the point of activity cone intersection, this is due more to circumstances of population distribution in the region of the intersection than to some failing of the theory; for even in hill lands, the spatial influences of the centres located in the more productive lowlands lying adjacent to the north and south, meet at the point where access in the hills is greatest, i.e. at the junction of routeways from three directions. Further search for other examples of such lowland-upland integration within central place investigations may be profitable in adding a further dimension to the theory which would allow for a statement which would identify some of the conditions of the assumption in theory of a relatively homogeneous plain.(10)

The part of the study area lying within the Borders is dominated by a number of centres of fourth and fifth order. By comparison, third order places are not very dominant with the single exception of Duns. Peebles dominates in the western areas of the upper Tweed Valley, its activity cone intersecting Galashiels' along a line near which both Innerleithen and Walkerburn are located. Analogously, Hawick is dominant in southern Roxburghshire, and its cone meets that of Galashiels midway between them; two miles to the north of this mid-point, Selkirk is located. In both these cases, the locations of the centres lying near the activity cone intersections, are consistent with central place theory. Other centres associated with this same pattern are mainly first order and include Ashkirk between Selkirk and Hawick, and possibly Lilliesleaf (second order); Westruther lies at the intersection among the cones for Galashiels, Kelso, and Duns, and Grantshouse is near the meeting point among cones for Dunbar, Eyemouth, and Duns.

While several other examples of this point may be found, especially if sub-surface intersections are examined in relation to the location of first order centres, undoubtedly one of the more striking features of this map is the large trough of intersections lying among Galashiels, Selkirk, Hawick, Jedburgh, and Kelso. If the intersections here indicate great opportunity for contacts with surrounding centres, but no comparative advantage for any of them, then it would be expected that a central place should emerge. In fact St. Boswells and Newtown St. Boswells lie within the area of intersection, and the former increased in population by some 20 per cent. during the decade 1951-61. Although Newtown St. Boswells lost population, other and smaller centres, such as Ancrum and Lilliesleaf, were gaining because of the construction of Council Houses.

In these cases it may be argued that the centres do not conform to theoretical points because they do not lie exactly on the boundaries, But the zone of intersection is broad, and centres within that zone have been "favoured" by the boost of extra housing, indicating that those in positions of decision-making either simply recognize trends and try to accommodate them, or attempt to re-direct the trends. At any rate, there is an appreciation that pressures exist in this area and some effort is made to cope with them. (The last part of Footnote 6 is relevant to this point as it was in relation to the Lothians).

There are levels of appreciation of trends and levels of solutions for them, however. The considerable amount of official concern expressed over the Borders in the 1960's demonstrates this. Stemming from a proposal in the White Paper, The Scottish Economy 1965-70, a comprehensive report known as The Central Borders Report was drawn up and published in 1968.(11) It concerns the specific location of urban expansion associated with Galashiels, but more generally, is about the future of the Central Borders area and in the "Terms of Reference" was charged to deal with the attraction and settling of some 25,000 people to this area by 1980.(12) Clearly the settling of an additional number of people of this magnitude will create either a "New Town" or expand one or more of the old ones. Should one be "favoured", as Galashiels evidently is, then it will come to dominate. Suffice it to say here, however, that the zone of intersections among activity cones in the area is just that area considered in governmental circles to have the greatest potential for the development of a viable centre to service the eastern Border counties which comprise the larger regional context of the proposals.

The implication of this is that in a zone of potential growth, the emergence of a centre may result from the expansion of an existing place or from the development of a new one altogether. In the latter case, much more burden will be placed upon the conscious examination of alternatives and priorities, and more decisions will be made on a public level. But in both cases the operation of central place principles in bringing a new centre into being at the point of intersection between spheres of influence will be seen.

In concluding this discussion of the interrelations among activity cones in the study area, as observed in Map 42, the principal point which emerges supports strongly the central place theoretical contention that where overlap occurs among spheres of influence from different centres, the opportunity is greatest for the emergence of another centre at that point. Two particularly striking examples are found in this study area where proposals have been made for the official establishment of large centres at just those places where striking overlaps are seen in this study, and where population growth potential seems favourable, but where "spontaneous" growth has not kept pace with needs both to develop the local area and perhaps to relieve population pressure elsewhere.

The insignificance of focal participation in the upper Tweed, Yarrow, and Ettrick Valleys, and in the Moorfoot and Lammermuir Hills is also apparent. These areas are sparsely settled and, although served regularly from centres, and although the inhabitants are accessible to centres, the long attenuated valleys which must be travelled in order to make central contact are daunting. But, as discussed later in Chapter IV, the pattern of functional integration of the most "remote" areas with some of the most important central places on a regular basis, may have

significance for central place theory.

In summary, the Tweed Valley and East Lothian may be seen to display a system of activity cones which illustrate the principles enunciated in central place theory, with centres being quite regularly coincident with activity cone intersections. In the case of Melrose, its activity cone is entirely nestedwithin that of Galashiels, but its proximity and ease of access to the latter place suggest a high degree of interaction in this central valley region. Such a pattern is dominant, however, to a greater extent in West and Mid Lothian where settlement is spatially concentrated; and Level A centres command much less aggregate participation from surrounding areas than do Level B centres. When it is recalled that Level A centres tend to have less functional diversity (at least those closer to Edinburgh have low diversity - see Map 7), then a high degree of interaction among centres may be expected in this area. This tendency towards the "dispersed city" was noted earlier, but it is referred to here in order to show its compatability with the tendency for the activity cone analysis in the western Lothians to support classical central place theory as regards the growth and decline of centres. This overall support for the theory in this area, encompassing, as it does, diverse empirical situations, is considered important, as is the integration of it with the "dispersed city" hypothesis in regions of intense settlement concentration, and with its apparent validity even in relatively empty regions. For these reasons, although systematic distributions for single purposes show considerable variations, the aggregates as summarized by the activity cones, are taken to be valid generalizations of the "total" influence of centres in the area and demonstrate also the conformity of individual places within the system of centres.

III(c) FOOTNOTES

1. Not infrequently in the hill areas tributary to these centres, interviewees referred to a van service which had been reduced or eliminated through lack of custom, or was about to cease in the near future. In cases where hardship follows such reductions, a compromise is sometimes reached whereby special orders may be sent relatively easily or, what amounts to about the same thing, a full service would be supplied but only on a weekly or even fortnightly basis. Sometimes orders are left at homes which are easily accessible to the vans, and are then picked up by somebody from a house away from the road. From the point of view of the van merchants, it seems to be an accepted practice, particularly in the co-operatives, that such extra efforts are part of the responsibility that is implied by the business, and the author was surprised on more than one occasion at the apparently casual and very humane acceptance of uneconomic routes within the organization; but their closing or reduction is the final reality in areas with declining populations.

   Polwarth, near Duns, is a good example of a small village which has rapidly diminished in recent years. This is a "green" village consisting to-day of only three cottages scattered around two sides of the green, a schoolhouse and the former manse which are now both private residences with an antique dealer inhabiting the latter, and the kirk now linked with Langton in a combined parish. The former village hall lies virtually in ruins as do two other cottages on the green. The writer was assured that less than a decade has passed since Polwarth "flourished" with men's bowls on the green, dancing in the hall, and children in the school.

2. Berry, B.J.L., and H.M. Mayer, Comparative Studies of Central Place Systems, Final Report, Project NR 389-126, NONR 2121-18. Washington, D.C.: U.S. Office of Naval Research, Geography Branch, February, 1962. Comparative spatial differences, rather than temporal development, were the bases of Berry's conclusions. They have since been applied and tested in a German setting and are found to have general validity there. See Barnum, H.Gardiner, Market Centers and Hinterlands in Baden-Württemberg, Chicago, University of Chicago Department of Geography, Research Paper No. 103, 1966, Chapter V.

3. Godlund, Sven, "The Function and Growth of Bus Traffic within the Sphere of Urban Influence", Lund Studies in Geography, Ser. B, No. 18, 1956. See Figure 15.

4. Kopec, R., "An Alternative Method for the Construction of Thiessen Polygons", Professional Geographer, XV, 1963, pp. 24-26; and Haggett, P., Locational Analysis in Human Geography, Edward Arnold, London, 1965, pp. 247-248. Although the dividing line separating the influence of two towns has this property of a slope upwards from the ends to the middle because it represents the intersection of two surfaces, no specific mention of this appears in the literature.

5. Dalkeith's activity cone extends to the south and west of Edinburgh in this depiction, in some defiance of reality; both the Pentland

Hills and the influence of Edinburgh act as barriers to prevent this. But no attempt is made to give a more "real" appearance because the limiting assumptions of a featureless terrain and the ignoring of Edinburgh's influence in this discussion must be upheld across the whole study area.

While North Berwick and Dunbar have cones of equal intensity with Haddington, the former's constricted area of dominance and the latter's interests in the sparsely settled coastal areas of Berwickshire are considered to place them in less dominant positions in the Lothians than Haddington occupies.

6. Compare, for example, with Map 3:1 , "The Survey Area: Principal Settlements 1961, and Planning Areas", pp.16 in The Lothians Regional Survey and Plan, HMSO, Edinburgh, 1966. During the mid 1960's, popular discussion concerning the Livingston New Town developments emphasized that it was the first New Town to be planned in relation to its region. While it was rarely pointed out in informal discussions this writer was party to, what is nevertheless a strong argument is that this "region" will only be "known" as a result of the establishment of the town itself. As a starting point, however, the survey area for the study was defined as the parishes of Bathgate, Ecclesmachan, Kirkliston, Livingston, Mid Calder, Kirknewton, Uphall, West Calder, and Whitburn. But it is considered fundamental here , in appraising this procedure, to recognize that it parallels the popular mind in a growing awareness that centres develop in relation to areas, that this includes relations with other centres, and that the recognition of an advantageous location for a new centre involves some indication of potential viability through a projected high level of interaction. Such an awareness represents the acceptance - perhaps intuitively - of central place principles.

7. These are Ratho Station (+124%), Ratho (+54%), Wilkieston (+45%), East Calder (+54%), Mid Calder (+25%), and Pumpherston (+22%).

8. Ministry of Works,"The Preceptory of Torphichen," one of a series of explanatory leaflets entitled Ancient Monuments of Scotland. The leaflet is undated but carries the number DE 10694/12A DL.

9. The relevance of historical explanations of locational patterns in the hierarchy, and the degree of their validity, are questions which deserve further investigation. While a specific aspect of such enquiry is taken up later, a useful starting point would seem to be the recognition that "a settlement is a point in time as well as a point in space". As time passes, settlement locations increasingly reflect the influences upon them; if such influences remain similar in nature and degree, the settlement pattern gradually should become increasingly "perfect" with respect to its fitting these influences. When they change, so the settlement pattern in time should alter. Where a centre's location is compatible with the settlement patterns across more than one such stage, however, it does not necessarily lead to the inference that "historical" factors validly explain a persistent location. Rather, it seems more meaningful to recognize that the identity of a centre varies with time, that the viability of a centre may also vary, and if a location is suitable to the developing settlement system, it will remain constant only because of that persistent suitability. In this context of adaptation the contemporary

explanation would seem to be more powerful than the historical one to account for hierarchical settlement location patterns.

In the region west of Edinburgh rapid changes are occurring with the mining landscape being transformed as the re-housing of people proceeds and the older dwellings, now often considered unsuitable as to standards and conditions, are removed. In the process locational changes are bound to reflect contemporary demands upon the locational structure of settlement. The progressive incorporation of life with Edinburgh, and the increased movement along an east-west corridor are seen as major influences; these are not necessarily incompatible with central place theory, but they do refer to a higher order of development in the hierarchy.

10. While it is true that the tendency towards the regularity of settlement development is all that is needed to suggest the validity of the theory , the hill areas in this case have virtually determined where the route junctions may occur most conveniently, and this is at the valley junction. There is no other such meeting of valleys in the immediate area north of Innerleithen. Therefore in an overall comparably flattish environment where a selection of routes may be possible and available, and centres may be located among a number of choices, the theory will be seen to be operative; but where there is little or no alternative for the point of greatest access, and the settlement patterns expected in a relatively similar overall environment are not negated by a sharply altered one, further theoretical validity may be suggested.

11. The Scottish Economy, 1965-70, a Plan for Expansion, Edinburgh, HMSO, Cmnd. 2864, 1966, Paragraph 232.

Scottish Development Department, Edinburgh. The Central Borders: A Plan for Expansion, in 2 vols., Vol. I, 116pp. + ix; Vol. II, 88 pp. + viii. HMSO, 1968.

12. The Central Borders: ibid., Vol. I, pp. 1.

CHAPTER IV

SYNTHESIS AND EVALUATION

At the outset of this study several conditions are specified which affect the types of data collected, the questions which must be approached, and the place of this work in relation to the general body of Central Place Theory. It is desirable here to recapitulate these conditions briefly in order to clarify, in this chapter, the evaluation of findings.

While most studies dealing with the attraction of central places in relation to a surrounding population have considered population to be an overall aggregate, the approach adopted here is that qualitative differences among socially differentiated sub-groups of the population should be recognized, and thus the study is limited to information regarding activity contacts with centres by "working class" people only. Preliminary investigation indicated that the reasons such people visit centres are fairly exclusively in connection with personal and/or household needs, and therefore the enquiry in the field was limited to these. Consistent with this , the functional structure of centres is analyzed solely with reference to facilities to which individuals of the general public have direct access for their own individual purposes. Having thus specified conditions which limit the considerations, it was necessary to determine the nature of the settlement hierarchy and of hinterlands of central places in the study area. Thus the broad questions outlined at the conclusion of Chapter I(a) have guided this investigation, and the results are presented

here in a manner consistent with those questions.

(a) The Functional Character of Centres in South-east Scotland

The functional character of centres refers to retail and service facilities, along with those devoted specifically to educational, religious, and social activities. The number of such facilities for each centre was totalled from field inspection, from various lists of types of facilities and their locations, and from the Classified Telephone Directory for the Edinburgh Area. The total number of types of facilities and enterprises in the area is so great that a scheme of classification is necessary in this study. The functional classification developed recognizes twenty-four separate Categories on the basis of grouping the facilities by types. Subsequent analysis, except in the case of first order centres, is carried out within the framework of this classification.

The characterization of the functional structure of centres includes the identification of trait complexes of activities for all hierarchical orders and, at the same time, distinguishes between those of Level A and Level B on the basis of the population per facility ratio. For first order centres the individual facilities may be used as the components of the trait complex, comprising the kirk, primary school, public hall, sub-post office and/or general shop. This essential group is identified on the basis of their frequency of occurrence across all first order centres and by the manner in which they typically group together in many centres. For places of higher order, that is, second order and above, the essential trait complexes are identified upon the basis of frequency of occurrence in all centres, but the component units are Categories of the functional classification rather than individual facilities. This identification, therefore, does not provide a check-

list of items which would facilitate rule-of-thumb designations of central place importance; rather it indicates those general areas of service which characterize places at different hierarchical orders. For example, Category 23, Financial institutions and services, includes not only banks, but also accountants, building societies, hire purchase and insurance facilities of all kinds; each activity deals in financial matters, and the availability of such service in a varied, general form is considered more fundamental in the functional characterizations of centres than is the specific physical presence of a bank branch.

For all centres of second order and higher, taken together, the principal functional components are identified by Category as: food retailing; restaurants, cafes, hotels, public houses, and roadhouses; building trades and materials, household and property maintenance; public assembly halls and entertainment centres; and medical, health and social services. In addition, motor trade establishments, and educational and religious institutions are important, but to a lesser degree. Each order and Level of centres is characterized by its own trait complex as detailed in section II(d)(ii). In general, however, higher status is associated across the hierarchy with the following functional Categories: department and variety stores, news services, cycle and cycle accessories, other retail (i.e. those retail facilities not specifically associated with any Category), professional services other than medical, booksellers and stationers, and jewellers, leather, sports and fancy goods.

The advantages of casting the functional structure of centres in terms of a functional classification are that, in this study, those areas of activity and service which are evidently fundamental in south-east Scotland are dealt with as such rather than the varying individual examples of these activities. Moreover, by dealing with Categories of functions,

cross-comparisons among centres are both feasible and meaningful; this could hardly be so readily accomplished if individual facilities comprised the units of analysis, for there are some 6,500 of them in the study area. A further point here is that the identification of units of facilities by a typological approach facilitates cross-cultural comparisons because a type of activity may be common to several societies but the forms of its expression may differ markedly; this study then may contribute to the internationally-based conclusions regarding settlement theory which are gradually emerging.(1) The disadvantages of this generalizing procedure are that detail is lost and it is not necessarily possible to identify specific facilities in a centre from the title of a Category. But the type of activity may still be identified, even if a specific facility may not. Therefore it is felt that the procedure adopted in this study is reasonable, its success being judged, however, by its results.

One specific set of results concerns the correspondence in this study of the nesting pattern of functions with the central place principle that, as hierarchical order increases, functions of lower order centres are nested within those of higher order. As the detailed analyses of section II(d) demonstrate, this principle is strongly supported in this study at both Levels A and B in the hierarchy. Another set of results refers to the clear identification of functional characteristics of centres as summarized above. Such results, by implication, justify the use and derivation of the functional classification .

(b) The Nature of the Hierarchy

Because of the data and study specifications, recapitulated above, it is necessary that this study establish certain basic characteristics of the nature of the settlement hierarchy in the study area. Many

studies in other regions attempt to indicate whether a stepped hierarchy exists or whether centres form a rank-size continuum. Where functions are considered, usually fairly discrete mixes characterize centres of various sizes, whereas where population alone is considered, a continuum often is found. A continuum is usually demonstrated where large samples are studied. In the present study the relationship between number of people and number of functional facilities is identified graphically and it is possible to identify clearly four divisions across the scatter of points and thus to define a hierarchy of five orders, the lowest being designated first order, and the highest fifth order. (Figure 2) These divisions are sufficiently clear that they are taken to indicate the existence of a stepped hierarchy of settlements in south-east Scotland and therefore to give evidence from this area that a continuum of centres, arranged by population per facility, does not describe the hierarchical structure of settlement. Subsequent analyses rely heavily upon these divisions and the further regularities identified are felt to imply that the stepped characterization of places is valid in this study.

Based upon the population per facility relationship, two distinct groups of centres are further identified at all hierarchical orders except the lowest. Level A centres characteristically have high population per facility ratios whereas Level B centres have low ratios. This division is considered significant inasmuch as the areas where these centres are located are spatially discrete, therefore identifying a fundamental division within the study area. Central place characteristics are identified subsequently and are analyzed in terms of the comparisons possible not only among various hierarchical orders but also between Levels A and B. This comparison provides a constant point of reference in this study as the nature of the hierarchy is gradually elaborated.

(c) Contact Locations with Centres

(i) Centres excluding Edinburgh

Much of the field work in this study was associated with the attempt to define central place orientations of the landward population for goods and services. The reasons for which contact information was sought were those for which information was judged, in trial interviews, to be most accurate and readily forthcoming. The assumption was made that, in aggregate, these criteria for the choice of purposes to be studied would also indicate the more important central functions as perceived by people in the countryside. The high correspondence between these purposes (as shown in the mapped distributions) and the functions occurring in all centres at each hierarchical order and Level (Table 8), is felt to justify the assumption. The intention of specifying type of purpose for contacts was that systematic distributions of contacts for centres could be analyzed for each purpose.

Perhaps the single "commodity" distribution yielding the most potential for interpretation is that describing food purchase contacts because a temporal dimension is added there which allows extra perspectives on the character of the distributions. Specifically, it may be noted that central convenience may not be a major determinant of the pattern of contacts with a centre, because the contacts are only partly made through individual customer effort. Rather, because so much food retailing is carried on by mobile shops, factors such as co-operative society membership plus routing convenience are very likely prime determinants of the shape of food purchase contact hinterlands, and reflect to some degree the density of population. Evidence that routing convenience determines the contact

frequency for food purchases may be broadly inferred from Map 9 which indicates total weekly contacts with all centres for this purpose. The correspondence between higher frequencies and the paths of main roads is to be noted (compare with Map 1), as is the general correspondence of high frequencies with areas of higher road density, the latter reflecting local accessibility to the population. (Map 43).

A specific point regarding hinterland morphology is also brought out by the food purchase contact distributions. The "shot silk effect" is recognized in the case of Chirnside particularly, where the hinterland passes across those of two nearby centres with which Chirnside does not lie in a locationally central relationship. (Figure 32)

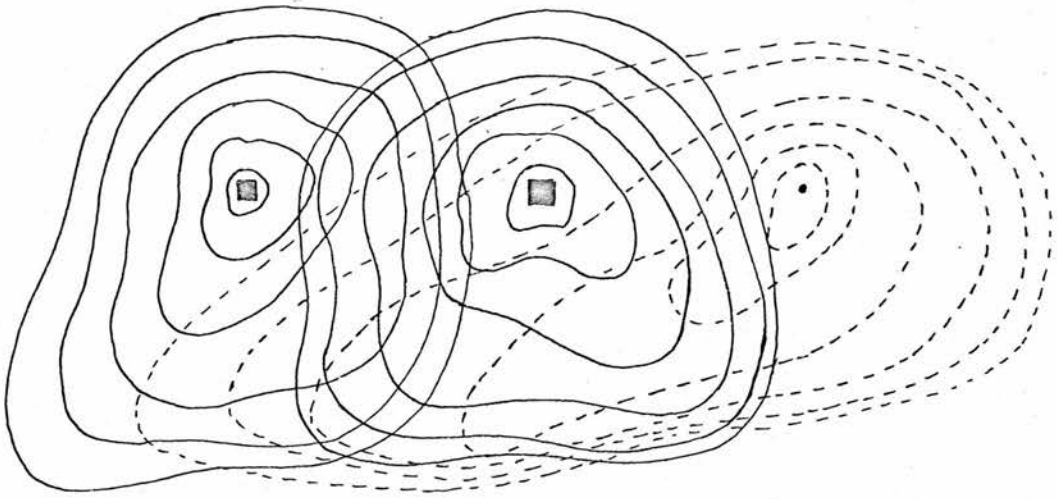


Figure 32 -- The "Shot-silk Effect" in Hinterland Morphology

Further, because Chirnside is not a dominant centre in the area, its hinterland would not be expected to extend in this manner. It is suggested that the circumstances of this pattern include a specialized offering (milk) which is successfully competitive in a wider region than would be expected following central place theory; the "effect" would not be expected if the "total" influence of centres were to be considered. The offering should be based in a smaller centre than those whose hinterlands it penetrates; if it were larger, the

centre would merely "dominate" the others. Where these conditions are found, the "shot silk effect" may result. In the particular instance it helps that the commodity sold is perishable and is habitually purchased frequently, if not daily; perishability and the habit of frequent purchase, however, are not necessary to the existence of this effect in hinterland morphology.

Other distributions are shown and discussed systematically, being grouped for the purpose according to the similarity of the profiles of contact intensity and extent. Thus distributions having only restricted areas associated with centres may be seen to represent the spatial manifestations of the trait complexes of lower order centres. Those having expanded areas associated with centres correspond with the expanded trait complexes of higher order places. Each activity whose distribution is represented on the maps and separately discussed is, however, but an example of the several distributions which occur for activities within one Category of the functional classification. But as Table 8 shows, these individual distributions represent ten out of twelve Categories used in the analysis of functional diversity. As these Categories are selected on the basis that every centre of third order and above is represented in them, the distributions shown are felt to be as complete in their number and as representative as possible of all the activities about which information could be sought specifically.

The amount of overlap between contact locations associated with different centres varies considerably among distributions. Those which show the most overlap, such as clothing and automobile purchases, correspond to those contacts for which selection and choice are more importantly associated with comparison shopping. Moreover, they are commonly items of some considerable price and also involve a degree of personal pride;

hence they are items for which the multi-purpose trip principle is less important.(2) Those contact locations showing least overlap are those for which hinterlands are specified at a higher level of decision, such as in schools' catchment areas, and also those for which specific trips with no comparative analysis of price or convenience advantage is relevant, such as dentists' areas. In the case of schools organization, it is a problem of overall efficiency because characteristics of shifting population and the established investment infrastructure demand as rational a scheme of area service as possible.(3) The fact that unplanned distributions may be just as "efficient" while allowing more individual freedom of movement, raises the speculation that in activities supported by the public through its government, certain organizational rigidities may be the natural consequence of having to direct the distributions rather than to accept what distributions develop. A modification of the form of hinterlands is to be noted in West Lothian where scholars' tickets are issued for regularly scheduled buses and the school a child attends is determined by the educational authorities by matching residence and school locations along lines of bus access rather than simply by the physical proximity of home and school. But this modification does not alter the basic frame of decision reference, nor the imposition of rigidities upon the forms of hinterlands. There is a sense in which this represents the ultimate "market control" which Galbraith discusses in principle for the developing corporate economic structure of Western societies as a result of the growth of technology.(4) If so, geographical enquiry may carry useful perspectives for understanding the directions of social activity as they relate to problems, not only of the mechanics of servicing a population, but also of human freedom at various group and individual levels.

(ii) Contact locations with Edinburgh

Because of the obvious importance of Edinburgh in the study area and the numerous references made concerning personal contacts with it by interviewees, contact locations with the City are illustrated cartographically as they are for other centres. These distributions indicate considerable variation with some, for example, doctors and public houses, being hardly represented at all whereas others, such as clothing and television sets, show strongly in the Lothians.

Edinburgh's position is so clearly dominant in the study area in general terms that its apparent absence of influence in the Lothians, for the purposes of contacts represented on the maps, requires brief comment.

Because Berry's 1960 study deals directly with a similar problem, it is referred to here as a point of comparison.(5) Berry notes that as commuting ranges increased around Seattle, functional shifts occurred among centres such that: a) higher order facilities concentrated both in Seattle and in one smaller, nearby city, Everett; b) functional specialization proceeded in business areas of most centres; c) "residential imbalances" occurred within the commuting range, resulting in high "population/function ratios".

Each of these conclusions is paralleled in the area about Edinburgh. a) The desirability of visiting Edinburgh for high order goods and services, and the operation of the multi-purpose trip principle, would tend to concentrate sales facilities in the City. Dalkeith is a lesser centre which appears, even in Edinburgh's "shadow", to be prospering as a hinterland-serving place for high order commodities. b) Low diversity indices are taken to reflect the condition of functional specialization in centres near Edinburgh with Dalkeith's prominent service position being

represented by its high diversity rating, indicating the effects of its greater variety of functions, some of them of high order.(6) c) Level A and Level B centres are distinguished in the hierarchy by their population per facility ratios. But in south-east Scotland the imbalances are only partly explained by the commuting pattern. Historical circumstances of settlement in mining communities where densities were high and remain so, and where services are relatively few, provide a persistent heritage of high density settlement in the area. Thus at least one additional perspective, that of the historical regional economy, may be added to the "commuting" explanation advanced by Berry for such imbalances. From this the concept of "metropolitan dominance" may be seen to describe centralization of activity in the hierarchy; but the process is functionally selective of high order activity and, probably, as Berry suggests, represents a special case of functional centralization throughout the hierarchy.

(d) A Brief Comment on Modes of Central Contact

"Modes of central contact" are considered here to refer to, and to distinguish, centripetally-oriented contacts -- the "norm" in central place investigations--and centrifugally-oriented contacts.(7) In this study an analytical distinction between the two has not been drawn up to this point, the pilot field work having failed to reveal some of the subtleties involved in the formation of hinterlands which are exposed by this distinction. In numerous places in this study, however, reference has been made to the operation of vans, and their importance has become evident; moreover, apart from Wheeler's 1960 paper on mobile shops in Sutherland, two other studies, by R. Helle and by R.J. Johnston were published during the time this present study has been in progress, and they throw

some light on the question.(8) The following comments, however, arise from this study, but where they may be usefully compared with the work by others, the comparison is drawn.

(i) To the customer, retailing by van offers certain advantages. Fresh food may be procured frequently, at least weekly for almost all persons, and an exact schedule of calls may be identified. This frees the householder from having to set aside time for visits to shops with the attendant problems of queuing and carrying bulky purchases. Its disadvantages seem as clear, however. The price of goods on vans usually is somewhat higher than in shops and the selection of commodities, especially towards the end of a route, may be quite restricted.

(ii) To the entrepreneur (and thus to the central place itself), the advantages are that a mobile shop is a comparatively cheap and flexible form of retailing, offering immediate response to changes in population distributions without detriment to the value of the fixed capital investment. If a shop's trade should decline, losses incurred owing to the fixed nature of the capital invested in the shop itself, may be considerable and it does not possess the flexibility of the mobile shop to accommodate changes such as population re-distribution; in these circumstances, a fixed shop in a centre may represent a greater potential liability than does a van. The response of the mobile shop has been mentioned at several points in this study where, in areas of population decline, a "reaching out" for further contacts appears to characterize the behaviour of vans.

The disadvantages of mobile shops to the entrepreneur are that extra storage space must be provided, more labour is needed, and the expense of maintaining a van may be considerable. (Although now a dated figure, Wheeler indicates that an average of thirty shillings per mile was estimated

to be necessary for the successful operation of a van throughout the year in Sutherland.) Further, if, by the existence of mobile shops, people avoid frequent trips to the centre, the general activity of the place will decrease because facilities to service the daily or weekly influx will not develop, and those who would operate such extra services would not be present to contribute to a larger "internal" market. In this context, if vans reach out further to maintain sales levels when population is declining, they are also the instruments of further decline by making unnecessary extra service people in a centre. The logical extension of this reasoning is that provisioning the countryside by van may be carried on from a warehouse and not a central place at all; already, in the case of the large East Lothian Co-Operative Society, many people are really dependent upon Tranent for their supplies but are so effectively remote from that centre themselves that they might well conceive it to be merely "their warehouse". Certainly they would be very unlikely to reciprocate with their own centripetal contacts with the burgh. Where mobile shops have the effect of cutting down travel to centres, the fares spent on buses are effectively transferred to the vans, thus covering some of the extra cost of this method of provisioning.

Mobile shops in growing areas have what would appear to be an almost opposite role. Where demand outstrips supply in provisions, a common condition in new, high density developments, vans, being flexible, may be deployed to service the demand and therefore demonstrate the point that excess profits (of fixed shops) may indeed be earned; the arrival of vans on the scene in growing centres, such as some of the Level A places, does not herald the demise of the fixed shop. The vans may be viewed as supplying the "excess demand" and hence diverting the "excess profits".(9)

(iii) <u>The settlement pattern</u>: Where settlement varies in the degree of

nucleation, as it does in south-east Scotland, it is noticeable that vans call more frequently and in greater numbers at clusters of dwellings than at individual residences. The advantages of doing so are obvious: less travel cost and selling time are expended to meet a larger number of customers and some incidental hawking of extra goods is more likely. Such differences in the frequency of central contacts, as among locations distinguished by their population clustering, if based upon a centripetal pattern only, would be much less clear. Thus the mobile shops would seem to emphasize points of nucleation in their routing patterns, and the frequency of contact with people in isolated dwellings would seem to be partly dependent upon the proximity of a nucleated cluster of people. (Footnote 1 in section III(b) points out the importance of such nucleation in the specific example of Chesterhill, between Pathhead and Dalkeith.) The mobile shop, adjusting so readily to variations in settlement forms, thus may determine also the details of hinterland formation both as to the intensity and extent of contacts.(10)

(e) The Relationship between Centres and their Contact Locations: A Centrality Index

Chapter II analyzes the settlement structure of south-east Scotland from a functional point of view, while Chapter III identifies, in locational terms, the extent and intensity of activity with centres from surrounding areas. Because centres at each hierarchical order display characteristics of discrete functional structures nested within the hierarchy, it is logical to seek an aggregate and integrative view of centres and their associated contact locations for each order.(11) This view is approached through the totals of contact locations per mile radius from centres; the resultant profiles for each centre are smoothed by taking running averages across three adjacent concentric rings, and then aggregating them by order and Level.

When applied to the centres themselves, the profiles form, in three dimensions, activity cones.(12) The only variables at this point of the analysis are distance between centres and the size of activity cones as between the different orders and Levels. The analysis of the total integrative view of the centres and contact locations is thus ultimately in terms of a morphology of activity in which hierarchical order, Level, and location determine the shape of the surface which represents the extent and intensity of central activity.

The surface configurations of the morphology of activity (Map 42) display certain regularities which conform to established central place theory. Particularly is this true when considering the existence of centres in the zones of overlap between activity cones of other centres. While this could be construed as evidence of a close link between the functional character of centres and the contact locations associated with them, it is circumstantial and invokes theory to prove fact. It still remains to demonstrate the degree of association and complementarity between centres and activity cones and thus to provide a synthesized view of functional regions.

At the end of section II(e) in which the functional diversity of centres is analyzed, it is concluded that the overall attractiveness of centres, or centrality, may not be adequately described by a measure of what Boesch has called the "qualitative" characteristics of places;(13) that approach considers the range of functions only, whereas the variety of choice among facilities within one type of function may be a significantly attractive feature of a centre. Thus, because there is no weighting applied in such a case - or the integration of "qualitative" with "quantitative" factors is not attempted - the diversity index alone is rejected as a description of centrality. What follows is therefore a derivation and application of an index of centrality; through it the functional analyses

of centres and the hinterland morphology of activity are integrated.

If functional diversity may be taken to measure the "qualitative" attraction of centres only in terms of a range of functions, it would seem appropriate to augment this measure by some indication of the number of facilities found in places. Accordingly, a Centrality Index for grades and Levels of centres may be derived as the product of the number of facilities and the diversity index. This may be expressed symbolically in the form

$$C = FD \qquad (2)$$

where C is the centrality index, F represents the number of facilities, and D is the diversity index. Because the centres are aggregated by order and Level in this study, however, the mean number of facilities per centre for each order and Level should be multiplied by the comparable mean diversity index as calculated from Table 9. But a further qualification must be introduced because the diversity index itself is not calculated using all Categories of the functional classification. Rather, the calculation is confined to those Categories listed in Table 8. Therefore the Centrality Index must be a product of the mean diversity index and the mean number of facilities per centre as included only in the twelve relevant Categories. The calculation of the Centrality Index, C, is shown in Table 11.

A consistent relationship between Levels A and B is found in the greater centrality exhibited by Level B places. The discrepancy is greatest between fourth order centres, with the least being between fifth order places. This is consistent with the importance that Level B fourth order centres demonstrate both functionally and in terms of contact locations. Many Level A centres of this order cluster near Edinburgh or Bathgate, and thus are overshadowed by the stronger centres nearby. Their comparatively low centrality is therefore understandable for reasons developed in section IV(c)(ii).

Fifth order centres display a far closer degree of comparability

TABLE 11

DERIVATION OF CENTRALITY INDICES

Type of Centre	F	D	C	C/100
II A	18.2	-	-	-
III A	53.7	54.6	2932.02	29.32
IV A	109.5	54.4	5756.80	57.57
V A	244.7	57.9	14168.13	141.68
II B	28.3	-	-	-
III B	77.8	59.6	4636.88	46.37
IV B	149.1	60.6	9035.46	90.36
V B	264.0	57.1	15074.40	150.74

Notes: 1) Centrality indices for second order places are not calculated because diversity indices cannot be calculated for them. See section II(e).

2) F - equals the sum of the mean number of facilities per centre included in Categories listed in Table 8. Number of facilities per centre are listed in Appendix E.
D - is the mean diversity index for centres at each order and Level of the hierarchy. From Table 8.
C - is the Centrality Index.
C/100 - the Centrality Index reduced to a convenient magnitude.

of centrality, reflecting the importance of fifth order centres at Level A, and illustrating their marked superiority over all other Level A places. The close match between the Levels A and B centrality indices reflects similar magnitudes in the mean number of facilities in the Categories considered, and similar diversity indices. Thus the factors of the product which is the centrality index are similar, indicating an overall comparability. It is recalled that in Figure 2, where Level A and B centres are distinguished, fifth order centres are not as clearly divided as those of lesser order although it is felt that the decision to recognize the Levels at this high order is correct as argued at that point. It is appropriate, though, at this later stage of the investigation, where syntheses are being sought, that the functional similarity among fifth order centres should be highlighted.

The question may arise as to whether similarity of centrality

is reflected in the spatial similarity of contact locations. In fact the activity cone of Level B centres, with a radius of thirteen to fourteen miles at the base level of ten contacts per distance ring, is nearly double the radius of the base of the Level A fifth order activity cone which barely exceeds seven miles. This discrepancy may be interpreted as a direct reflection of the variations in population density (Map 2) For around Galashiels and Hawick the density of population is much less than it is around Bo'ness, Bathgate, and Musselburgh. In fact, the highest value isopleth in the Central Borders represents a density of 46.5 persons per square mile, whereas the highest value in the Lothians represents a density of 98.0 persons per square mile, or approximately double. It would seem reasonable therefore that Level A fifth order centres should have a relatively high degree of functional complexity while maintaining smaller hinterlands.

But the hinterlands are almost exactly one fourth the area of Level B hinterlands, while the population density is not four times as great. Two circumstances explain this. The first is that only the peak population density in the Borders reaches 46.5 persons per square mile, leaving most of the areas attracted to Galashiels and Hawick at very much lower densities. Thus, the centres must reach farther in order to maintain their functional strength. The second is that centres of lower hierarchical order lie close to fifth order Level A places, and the low relative centrality they exhibit suggests their dependence upon the fifth order centres, and conversely, the greater "market" of fifth order centres in terms of concentrations of population not included in the density calculations of Map 2. It is suggested that these circumstances of population distribution combine to provide roughly comparable markets for all fifth order centres, and that this is reflected in the similarity of centrality among them.

While Level A and Level B centres may have fairly similar centrality ratings, however, within both Levels the indices vary widely with hierarchical order. A plot of these values on semi-logarithmic paper permits the rate of change of centrality through the hierarchy to be observed.(Figure 33) In the case of Level A the rate is described by the regression equation log Y= 0.4246 + 0.3421X, whereas in Level B a lesser rate is described by the equation log Y= 0.9094 + 0.2560X. The comparison between these trends illustrates the tendency for Level A centres to be less important at the lower orders of the hierarchy but to approach closely the same degree of centrality as Level B centres as hierarchical order increases.

A similar plot for the volume of activity cones yields comparable results.(Table 12 and Figure 33)(14) Level A trends are described by the equation log Y = -0.4554 +0.4585X. Similarly, Level B trends are described by the equation log Y = 1.3265 + 0.2359X. A comparison of these Level A and Level B plots of activity cone volumes therefore reveals that the

TABLE 12

ACTIVITY CONE VOLUMES

Type of Centre	V	V/100
II A	405.2	4.05
III A	806.2	8.06
IV A	2546.3	25.46
V A	6660.0	66.60
II B	2604.3	26.04
III B	10580.8	105.81
IV B	19478.3	194.78
V B	31346.5	313.47

Notes: 1) V - represents the volume of activity cones
V/100 - represents the volume of activity cones reduced to a convenient magnitude

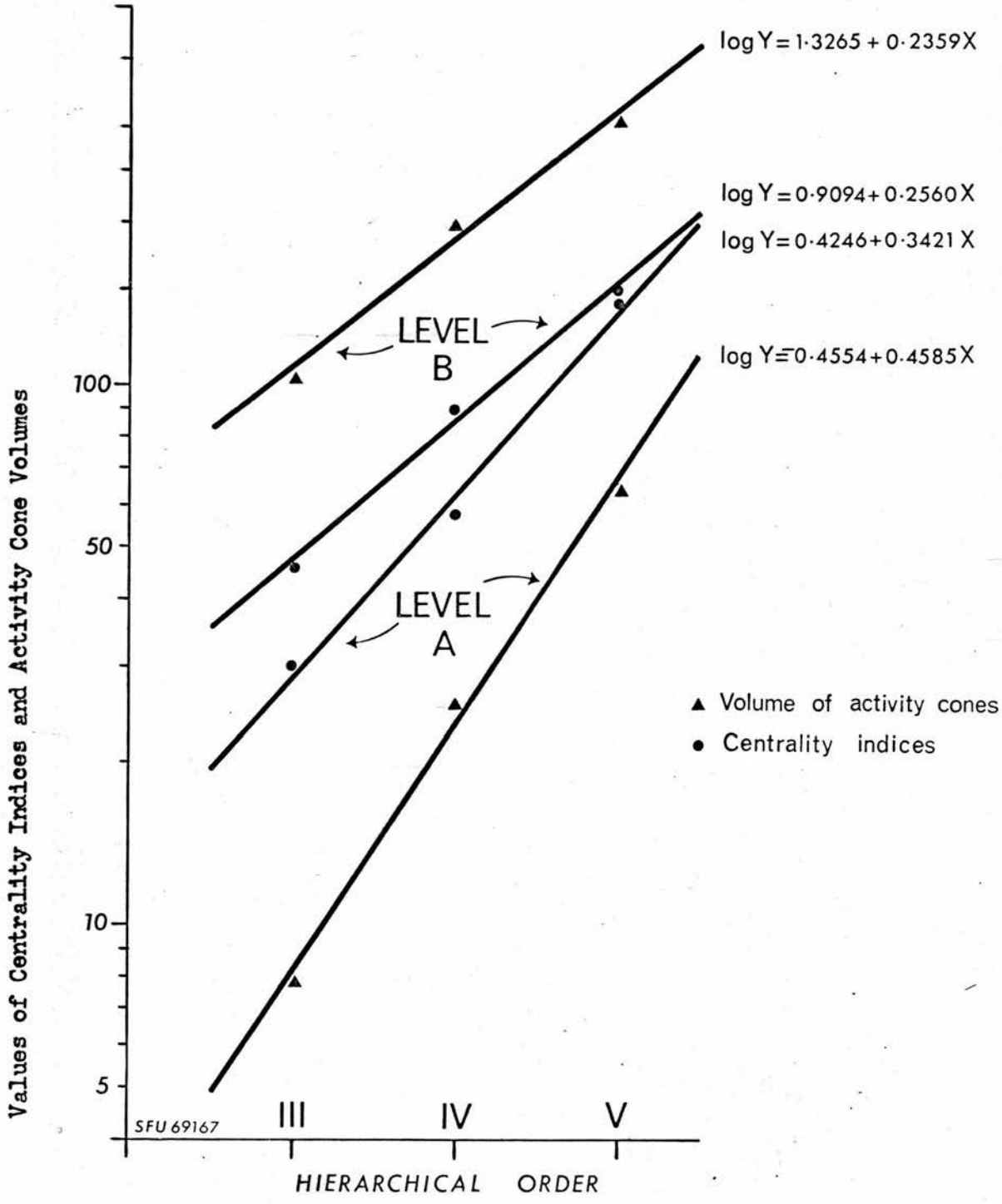


Figure 33 -- Progression of Centrality Indices and Activity Cone Volumes through the Hierarchy

volumes associated with Level A centres increase through the hierarchy more rapidly than is true of Level B places. Such differential rates of change are an expression of divergent trends within the hierarchy, recognized on the basis of the population per facility ratio, i.e. Levels A and B. Figure ~~33~~ 34 shows this divergence explicitly.

Centrality differences are interpreted above as reflecting different population densities, and activity cone volumes depend upon population density, their bases extending spatially as densities decline. Thus when centrality and activity cone volumes are plotted against each other, a straight line should be described, i.e. perfect correlation should be evident. (Actual correlation coefficients are: Level A - r = 0.9995; Level B - r = 0.9999; each may be taken as unity.) The divergent trends in the hierarchy are thus clearly identified. Regression equations show that: for Level A centres activity cone volumes increase through the hierarchy at only marginally more than one half the rate of increase of centrality indices ($Y=-6.37 + 0.52X$); for Level B centres, activity cone volumes increase at about twice the rate of centrality indices ($Y= 14.00 + 1.99X$).

It may be recalled that in section II(f) functional diversity was shown to vary inversely as the population per facility ratio. Because diversity is a component of centrality, it follows that centrality will tend to vary similarly if the other factor of the number of facilities is held constant. Specifically, centrality indices should decrease as population per facility ratios increase. Such decrease is likely to reach a minimum beyond which further decrease does not occur; conversely, further increase in centrality will not occur beyond some lower level of population per facility ratio. A limit will be reached in the former case where the tendency to a specialized set of functions reaches an effective maximum in the circumstances of proximity to Edinburgh or the possible development of a "dispersed city";

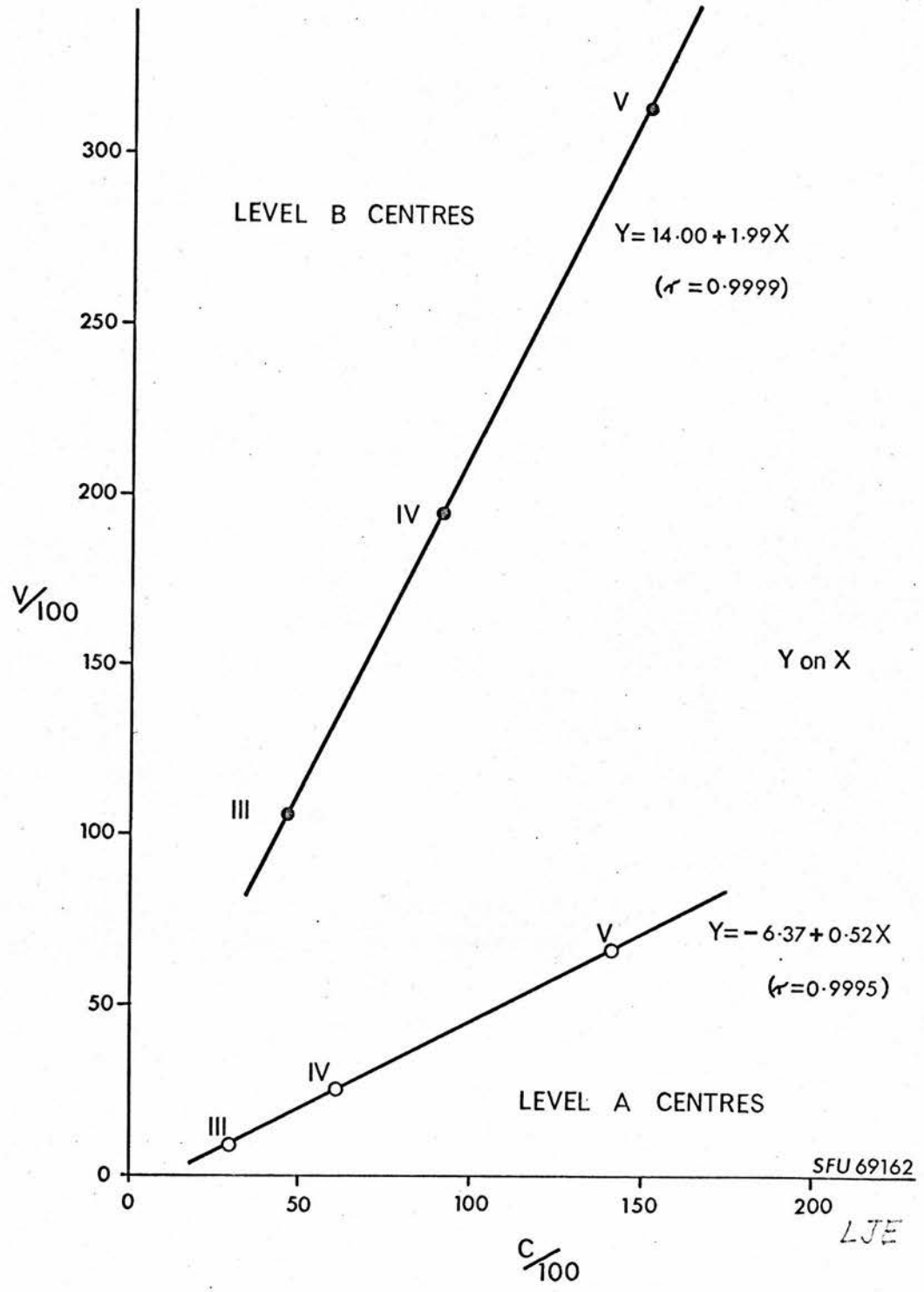


Figure 34 -- Regression of Activity Cone Volumes on Centrality Indices

the latter will reach a limit where a centre maintains only a minimum range and quantity of functions sufficient to service its hinterland without relinquishing service functions to other, perhaps larger, and more distant places.

(f) Accessibility and Interdependence

As a general principle, some scholars hold that an overall increase in communications both produces and reflects the condition of urbanization. Concomitantly, an increase in communications reflects an increase in accessibility and helps to form new concepts of distance.(15) One of the conditions of increasing communications is proximity and, although it may be possible to communicate efficiently over long distances with modern media, there is no question that the physical proximity of people is a desirable condition for the promotion of interaction.

Map 43, showing the density of roads, indicates the variations which exist across the study area in potential access. A sharp drop is observed away from the Forth lowlands and the main expanse of the middle and lower Tweed Valley. As between these areas, the zone dominated by Level A centres has an overall road density in excess of 1.9 miles per square mile, a concentration reached in only one small area near Duns outside this zone. The greater road density in the area of Level A centres provides a basis for greater access among points, and hence greater interaction than is possible among Level B centres, and this is complemented by the close spacing among Level A centres of second order and higher (mean of 1.44 miles) as compared with that among Level B (mean of 4.21 miles). By these standards, therefore, the zone dominated by Level A centres should be one of greater interaction and the centres should be more complementary than elsewhere in the study area. Such an interpreta-

tion is consistent with and supports conclusions reached from the study of the functions and contact locations of centres. (16)

Map 1 indicates, however, that the basic movement patterns of south-east Scotland involve a few well-defined "corridors". Further, Map 9, showing total weekly food purchase contacts, indicates that interaction is sometimes just as great along lightly populated corridors of movement as in areas of high population and road density. Thus a high measure of road density is not itself the determinant of a high degree of interaction, although it is a supporting condition.

Principal thoroughfares of movement, connecting major nodes of activity within and beyond this study area, reflect a high degree of contact. The two types of road networks, main corridors and meshes of lesser roads, interconnect in reality, of course, and complement each other. Where the movement corridors pass through areas of high road density, there the greatest potential for interaction may exist. This is particularly true of the zone defined by the distribution of Level A centres; in the Middle Tweed where the A 7 and A 68 routes pass from the uplands to the lower areas of the valley; and along the A 1 in East Lothian and eastern Berwickshire where the prosperity of Ayton in particular is evidence of this combination of influences.(17) The correspondence of these locations with areas of relative growth - implying interaction - or of potential growth, as recommended in recent studies, is striking.(18)

(g) Changes in the Settlement Hierarchy: Spatial and Temporal

The changes which are observed in the settlement hierarchy of south-east Scotland may be seen with both a spatial and temporal emphasis. Other studies, offering general statements of change with these respective emphases, are available to serve as both points of reference and comparison

for results of this study. Therefore this discussion turns on a comparison with results of Berry's work in the United States as regards the spatial emphasis and with Godlund's work in Sweden as regards the temporal. (19)

In section I(a) the main conclusions of the comparative studies carried out by Berry and Mayer in 1962 are outlined. These are that the spatial extent of trade areas is seen to vary inversely with the population density; that a functional shift, whereby higher order services occur in lower order centres, takes place as population density declines (across a traverse) because the expansion of trade areas, which compensates for the decline in market potential, lags behind the actual density decline; and that with density decline, centres become more widely spaced and trade areas more discrete spatially. These conclusions result from a spatial cross-sectional analysis, from Chicago in the east to south-west South Dakota in the west, and describe the stages of a pattern of spatial change involving a fairly regular progression of increasing or decreasing interaction and interdependence among centres, as population density varies. The stages recognized are, from outer margin to centre, "rangelands", "wheatlands", "corn belt", "dispersed city", suburban, and urban.

The conditions of Berry's study are not exactly comparable with those of the present study inasmuch as he dealt with some hundreds of miles of territory having relatively few topographic interruptions of the settlement pattern at a sufficient scale to affect the results. The present study area, however, extends to an approximate maximum of sixty miles across; it is bounded for about half its perimeter by coastline, and has sufficiently important topographic variations to provide an obvious structural framework of settlement as shown in Map 1. It is clear, though, that population density is the key variable identified by

Berry, and, in the area of south-east Scotland, sharp changes of population density exist. Therefore it is appropriate that the broad centre-margin model summarizing Berry's findings be a focus of comparison here. (20)

From a spatial point of view the distinction between Level A and Level B centres is fundamental in south-east Scotland, differentiating, as it does, two major zones by the ratio of population per facility. Within the Level A zone lie the main commuting locations for Edinburgh as identified by Strachan and implied by Macgregor, and in some cases what amount to suburbs of the city "spill" over its boundary into the county, for example, at Currie.(21) Further, at several points in this enquiry, the suggestion arises, from observing the differential diversity among Level A places, from the functional structure across the hierarchy at this Level, and from the implied greater possibility of interaction among Level A centres as compared with Level B, that centres in this zone functionally complement each other to a greater degree than elsewhere in the study area. These conditions all suggest a degree of support for the dispersed city hypothesis. There is thus general agreement with Berry's characterization of the change of settlement pattern from urban (Edinburgh specifically) to suburban (roughly the inner commuting zone) to dispersed city (generally high degree of interaction with and between different centres, mostly Level A, as illustrated on the contact location maps, especially Map 10.

Beyond the Level A - Level B boundary, including East Lothian, the Border counties, and southern Midlothian, lies a more open mesh of settlement largely oriented to agricultural pursuits in the countryside and therefore not reflecting the settlement history associated with mining through much of the Lothians and which promoted higher densities of settlement. Thus the activity cones of Level B centres are wider at their bases and, as time passes and centres appear to decline in importance, they should

widen further and the depth of cones should decrease as the intensity of interaction falls off. The zone dominated by Level B centres is not uniformly settled, however, for within it are areas of fairly close settlement which approach the dispersed city characteristics (The Central Borders or Middle Tweed), and these contrast with upland areas which are almost devoid of settlement. In between these extremes lies a gradation of areas such as the Merse or the attenuated tributary valleys of the upper Tweed.

It is notable that the most complex Level B functional centres, offering, in the Borders, within and among themselves, the greatest choice of services to landward populations, lie in the Middle Tweed region. This area is also among the most densely populated in the Borders. However, in eastern Berwickshire, where considerable dependence upon Duns (only a third order centre) is found, similar population densities also may be noted. At first glance this would seem to contradict Berry's conclusions that a reduction in the size of the central place should be dependent upon a reduced population density in the surrounding areas. But three circumstances intervene to clarify the differences where the Central Borders offer so much more in central service possibilities than eastern Berwickshire.(22) First, the large burghs of the Middle Tweed are industrial and service a large population internal to themselves. This is not true in eastern Berwickshire (excepting, of course, Berwick-on-Tweed which lies just outside the study area). Hence the Middle Tweed burghs are probably the less responsive to changes in the landward population density. Second, several villages of the Central Borders are apparently increasing in population and thriving economically, and these changes are not reflected in, and therefore compensate somewhat for, the general decline of landward population numbers; this circumstance is not parallel with that in the Merse where the numerous villages exhibit decline in population as part of the

overall landward trend. Third, Berry's model suggests a cross-sectional spatial change with specific reference to his study area; but in south-east Scotland access to Edinburgh from different points in the Tweed Valley varies greatly, even though distances may not be much different. Specifically, access is very much easier between the Middle Tweed and Edinburgh than it is from the Merse focusing on Duns. This factor of differential access combines with the quickening decline of population in the area of eastern Berwickshire to suggest that the latter area corresponds to a more distant zone than the Middle Tweed in an application of Berry's model, and that it is transitional to the relatively empty upland areas. Thus the model proposed as a result of empirical enquiry in the United States is further supported in this study; but the spatial view of the centre-margin construction yields to one of conceptual dimensions only.

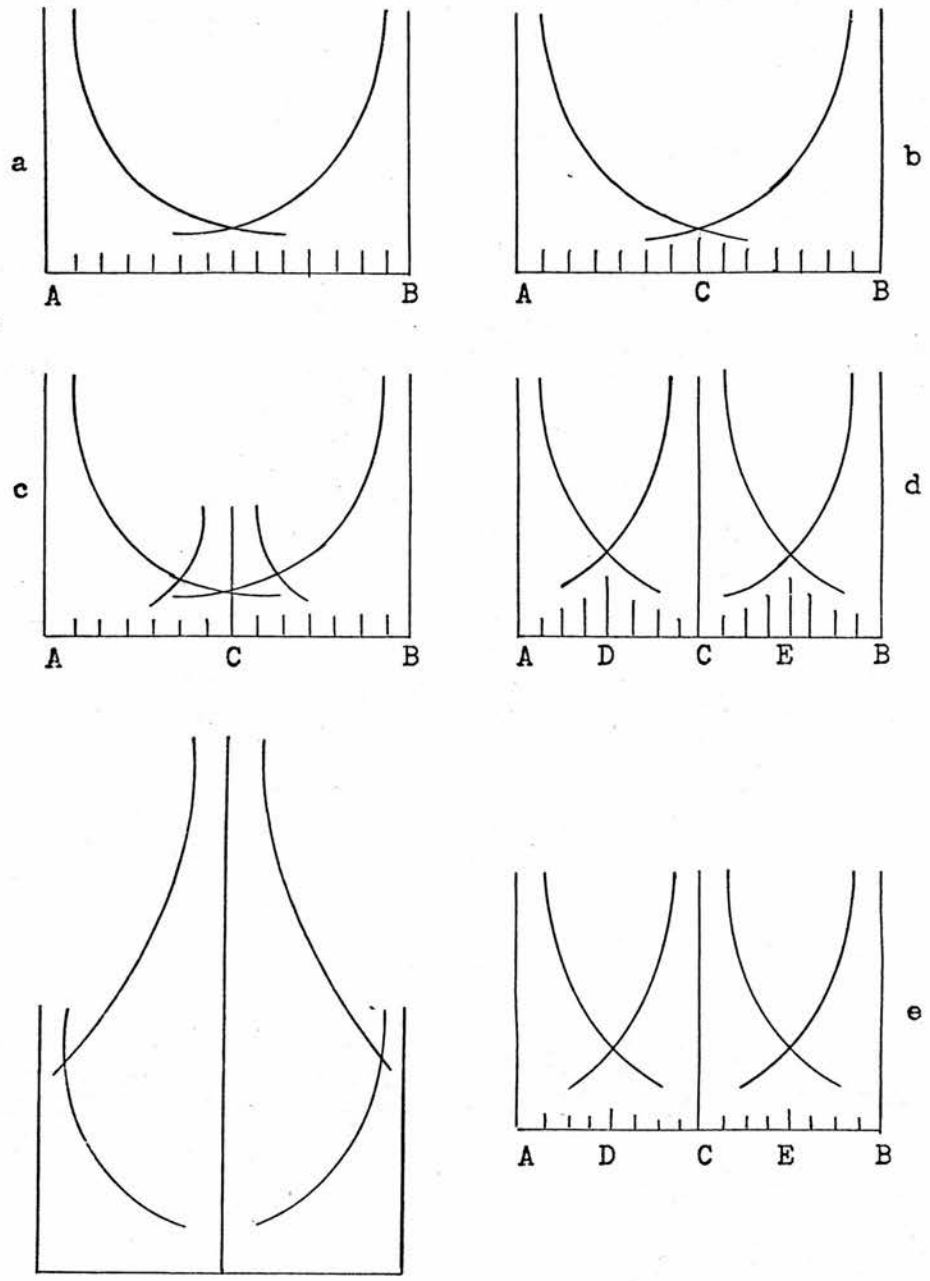
A further modification of the results proposed by Berry is implied in this comparison of uplands in south-east Scotland with the more remote margins of Berry's study area. In each case the population density is the lightest within the respective study areas; but whereas in the South Dakota rangelands and wheatlands, central places take on a functional character appropriate to their general regions, uplands in the present study area have comparatively easy access to the important centres of the adjacent lowlands, with the result that important central places do not exist in the upland at all, parts of which are now almost devoid of population. In functional terms this results in activity orientations which directly connect and intimately unite the extremes of the centre-margin framework. Therefore, if the remote margins of Berry's model may be generalized to include the relatively proximate but inhospitable uplands in the study area, the model may be regarded as applicable here; the necessary generalization would involve the recognition that distance to the urban core

is not a ready surrogate for accessibility in south-east Scotland as it was for Berry in the United States.

The statement of urban growth and decline made by Godlund in his 1956 study of the growth of bus traffic is conveniently referred to here for comparison because, although he was not the first to enunciate a theoretical position regarding the growth and decline of a settlement system in a central place framework (Christaller did so in his 1933 work), he develops a graphical presentation which is useful in this study.

Essentially, the process of urban growth and decline is described as in Figure 35. Assuming the ideal conditions of two equally attractive places separated by evenly spaced small settlements of equal potential centrality, it is shown that a central focus will develop at the point where the influence of the two established places is least. The intermediate place may grow to equal the outside pair and further intermediate places will develop. However, if the demand for central services is saturated, then further growth is arrested; if it is exceeded, or if greater access to the larger centres becomes easier, then a decline process, the mirror image of the growth pattern, will occur. The result will be more widely spaced centres.

It is noted above, when considering the morphology of activity, how closely the pattern of centres occurring in intermediate positions, where the influence of adjacent places is least, conforms to this statement of the location and growth of centres in a central place framework. Apart from general verification in this area, however, two circumstances likely to affect settlement permanently in south-east Scotland are to be noted. These are the proposals and actions in connection with developing the Livingston area (in the Level A zone of this study) and the Central



A suggested additional stage. For explanation see text.

Figure 35 -- The Urbanization Process as Described by Godlund (1956) with an additional Stage.

Borders (in the Level B zone).

Proposals concerning both areas appear to stem from a concern for the Scottish economy in general and also for the quality of life in the country. The relevance of the settlement structure to economic efficiency, and to problems of environmental quality as it affects the quality of life, are both appreciated, and proposals relating to both these considerations are involved. (23) The concern with these proposals in this study, however, is with the proposed locations for development in relation to the locations of established centres, and the implications these may have for a developmental theory of central places.

If the location of the Livingston area developments and that for the Central Borders is compared with Map 42, "A Morphology of Activity", the relationship of points of least influence from established centres is almost exactly coincident with the locations chosen for new developments. Other points of cone intersection are to be noted on the map, but those indicated by the locations for new development are the most prominent, being where several cones all intersect together. Thus, from the point of view of this study, the most obvious location in the Level A zone, and the most obvious in the Level B zone, are selected for development.

The magnitude of proposed development in each case, however, is such that existing places will be dwarfed, should the proposals be fulfilled.(24) And this raises the question of the interrelations among all the centres around each development point. In order to highlight this, it is suggested that an additional growth stage may be inserted after "d" in Godlund's model such that centre "C" would grow to at least twice the height of centres "A" and "B". (Figure 35) This would represent the approximate situation in the Central Borders if 25,000 people were attracted while the size of Galashiels remained constant. In the Livingston

case, the growth of the centre would outstrip its neighbours even more. Clearly adjacent centres may grow as a result of proximity to such strong growth points, but they would grow at a lesser rate and therefore decline relatively. Thus the additional growth phase added to Godlund's sequence may represent a special case of "e" where decline of intermediate places occurs at "D" and "E".

The influences which can produce such changes include those identified by Godlund as countryside depopulation and increased access over longer distances, and these parallel the spatial variations of settlement invoked by Berry to explain change across areas, i.e. population decline and, in less populated areas, the willingness to drive longer distances because of the relative absence of traffic congestion. The question then becomes, Why was an already existing centre not chosen for expansion, rather than building a New Town at Livingston, and mixing a pattern of growth of several existing communities with new development in the Central Borders? In the first instance problems of environmental quality, including an evaluation of potential site subsidence, were influential factors in choosing a new location. In the second case, a pattern of phasing is proposed which allows for the gradual development of population increase to become most marked at the point where the intersection of cones would suggest is most likely, that is, St. Boswells. The importance of this is such that the actual proposals for the Central Borders are highlighted here in order to put them into a central place theoretical framework. The following quotation from The Central Borders study is given and is interspersed with comments fitting the details of the proposals into a "phased" central place process.(25)

> "It is proposed that there should be population of about 100,000 by 1980 in a formal pattern of individual settlements closely linked by good road com-

munications and set in a beautiful landscape.

A planned population increase will be accompanied by an increase of access among all centres, either established or to be established. Environmental quality is a concern.

> "Within this pattern Hawick and Galashiels would continue to be the largest settlements, but the latter with an extensive population catchment in close support would become the main shopping centre.

Because only shopping is emphasized for Galashiels' development, and other types of service contacts may be maintained or initiated elsewhere, the interpretation here is that the implication of the proposal represents an unconscious attempt to "legislate" into existence the condition of the "dispersed city", or, conceptually speaking, to get as "near" as possible to the condition of the single, dominant, urban centre. Close road links in this area are consistent with this interpretation.

> "Hawick however would be the most self-contained unit due to extensive industrial development to offset its relative isolation. (Author's underlining)

This statement contains a further implicit tendency to plan the dispersed city. Admission of Hawick's present strength, but "relative isolation" - or lack of general access in the area - is the reason for its continued existence as a fairly "complete centre" rather than its potential strength as a participant in the proposed settlement pattern for the area.

> "The largest single population expansion would be in the St. Boswells area, which would create an important focus for further growth. (Author's underlining)

The greatest population concentration is to occur in the most likely place by central place standards, and it is recognized at least as an important potential growth point. The idea of a phased implementation of growth at such a point, in an atmosphere of burgh loyalty in the Borders, is appropriate because it cares for a certain negative attitude regarding

the proposals, and fits the practical necessities of allocating funds and resources in stages to this growth.(26)

> "The high quality townscapes of Jedburgh, Selkirk, and Peebles would remain tourist attractions, the last named expanding its role as a conference centre. Melrose would develop certain cultural facilities such as a museum and craft centre adjacent to the Abbey ruins. The major recreational area would be centred in the Tweed valley near Innerleithen."

This last part of the quotation seems to be a formula for what to do with centres with little potential in the scheme of proposals except in spin-off benefits from the main growth. It is significant that three fourth order centres are included here. The relative decline of all places mentioned is implicit and the fate of centres or areas which become marginal is clearly outlined in the proposal for some "exotic" function, involving little investment, as part of their future economic bases. The historic landscape, the preservation of artifacts, and the very lack of development become the resources in the plan for expansion. Selective change in the settlement system seems to imply relative growth and relative decline; and decline thus would appear to be an integral component of expansion.

Apart from the suggested modification of stage "e" in Godlund's representation of change sequences in the central place pattern, the process of change would appear to follow his stages closely and to corroborate them with empirical evidence from south-east Scotland.

(h) Theoretical Orientations Regarding Re-development in South-east Scotland

Two important development and re-development programmes are now going forward in the study area. Livingston New Town is being built in a planned re-location of people and activity in the Lothians west of Edinburgh, and the Central Borders Plan for Expansion proposes to firm the

future economic and population increases in the Middle Tweed region and thus to check and reverse the current decline in the Borders. The locations of both developments are consistent with central place principles and could be anticipated from the map of the morphology of activity. But these demonstrations of locational consistencies aside, the proposed developments are of such a magnitude as to suggest that a different order of hierarchy altogether is being brought into existence.

It may be pointed out that governmental involvement probably is due in part to the government's becoming aware that the lack of labour threatens the existence of the textile industries. Because of the excellent reputation of these industries in the export trade, it is commonly said that they should not go without assistance in dealing with the problems of labour shortages. But this is a national view. A local point of view would recognize more the employment which this industry provides in the Borders and, especially outside the burghs, employment for women. This local involvement is the more important at this point.

If the number of women available to work declines, it would seem that this decline is related to the loss of employment opportunities for men, particularly in agriculture. The creation of an expanded urban centre with an industrial employment base therefore represents the establishment of a centre lacking direct contact with the traditional environs of the place. This is the point at which local circumstances and needs, in terms of the existence of central places, are overwhelmed by the greater imperatives of national "designs", the opportunities and potentials of the area thus being remoulded and redirected from "outside" in the manner of "colonization". More will be said of this later but it illustrates that the proposals do not simply attempt to raise up a new central place within the settlement structure of south-east Scotland; the developments are

frankly regional and even national in scope and, as such, relate to a more extensive network of centres drawing strength from wider areas. As discussed later in this section, the Central Borders generally are the zone of intersection of inter-regional movement and therefore have the easiest access to other areas of the country. Official promotion of the developments for the area implies their success.

If the new developments are arresting one process (general decline) and redirecting change through others (investment in housing, job creation) in order to expand the economic activity and population of the area, then it is reasonable to enquire as to the relationship of the proposals and their outcome in a central place theoretical context. Accordingly, the remainder of this section outlines a central place explanation and then introduces an additional hypothesis to suggest a further dimension of understanding.

(i) A central place theoretical explanation

The context of this explanation would emphasize the rising standard of living and rising expectations for that standard. These accompany an improvement in communications generally, and an increased demand for goods and services which may be supplied economically only from fewer and larger centres to ensure sufficient market potential. Rising standards compound in this process, for greater scope in services essential to the maintenance of this trend, such as schools and medical facilities, must also be provided and done so in such a way as to maximize their services and efficiency. Thus, increasingly, it becomes a matter of concern that the best chances of success are ensured for such provision, and these chances are increased significantly if correct locations with respect to the distribution of demand are chosen. Further, it is clear that larger centres will multiply their offerings while smaller ones decline relatively,

perhaps even being reduced to offering only "convenience" goods or some "exotic" item for which people are willing to make a special-purpose trip and to forgo the economies of a multi-purpose trip to a larger centre.

Such a process of increasing centralization implies the allegiance of progressively more tributary territory and that the growth of a larger centre progressively usurps the functional position of smaller places. Especially would this be true in an area of declining population, such as the Borders. Evidence could be put forward to show that, in this area, the spatial concentration of economic activity and the provision of services at a level commensurate with expectations, has increasingly focused on the Central Borders. Thus the time has now come when the effects of the central place process have been observed and described at an official level, and policies concerning the future have been formulated. Thus, through the operation of central place principles, a major focus first emerges and then is confirmed.

(ii) An additional hypothesis

Although the central place theoretical explanation of the new planned developments may be attractive, it does not portray any of the relevant motivations for these changes aside from the standard "economic" explanation involving the efficiency of service provision. But the magnitude and scope of the proposals are such that the implementation of the recommendations may fundamentally alter the hierarchy. Further, the atmosphere of urgency which has built up since the publication of the White Paper on the Scottish Economy concerning the 'fate' of the Borders suggests that the motivations behind the developments are complex and more than simply those of effort minimization or of the rescue of an industry, important as they may be. While the central place explanation outlined above may be applied both in the Lothians and Borders, the hypothesis to be

developed here refers more specifically to the Borders. A series of points will be outlined first and then drawn together in the formulation of the hypothesis.

Developmental stages in the hierarchy: In 1956 Professor H. Carter wrote:

> "Before the Industrial Revolution there was clearly a better balance between the population of a town and its significance as a regional service centre. It was this balance...that the Industrial Revolution destroyed..." (27)

Because central place theory is basically a theory of tertiary activity, there is justification for this remark, as large concentrations of people in new industrial towns created quite different functional conditions. Although it may be difficult in practice to fix the point of "Industrial Revolution" in time, it would seem reasonable to claim that it nevertheless represents a great turning point in the hierarchical structure of settlement and, as Carter concludes later in the same work, hierarchical settlement studies logically must be viewed in the contexts of their own historical periods despite the practical difficulties implied in this conclusion.

It seems possible that the present study is being concluded at the end of an identifiable historical period in the settlement structure of south-east Scotland. On all sides "development" is being "planned" by numerous agencies, and the large part the various levels of government are taking in this trend implies both public concern and general approval. Very often the planning seems to involve little more than the recognition and formalization of existing development processes, but this continuing analysis of change is necessary to the understanding and re-direction of further change.

A variation of the central place process: The suspicion that an "era" is approaching its close in terms of hierarchical settlement structure,

and that the amount of attention attending such changes is indeed great, is consistent with a suggestion made by Professor J. Vance in conversation with the writer in May, 1968. Regarding central place applications in North America, it is suggested that the "raising up" of towns and cities as service centres to the countryside, is not historically applicable although it may have contemporary validity. The point of this suggestion is easily appreciated, for the process of colonization in North America often involved the establishment first of a service centre - a "jumping-off point" - from which the land was settled. The process involved working down the hierarchy as far as the local land office and "whistle stop" railway station for example. With reference to the "west", examples such as St. Louis at an early period, Winnipeg somewhat later, even up to the 1920's, and perhaps contemporary Edmonton, all come readily to mind. What "jumping-off points" had in common though, was some concentration of transport routes, often involving a break in type (rail, river, trail), where movement was funnelled. Such nodes are historically classic places for the development of urban centres and are so to this day.(28)

The structure of movement in south-east Scotland: The Plan for Expansion for the Central Borders contains a series of maps indicating movement "desire lines". These unfailingly show that most movement in the Borders of a more than local nature will pass through the Middle Tweed.(29) The convergence of movement corridors and the importance of non-local traffic are recognized in this Plan as being critical to the future development of the area; thus a decision to concentrate on the node of movement intersection is taken and justified.

The atmosphere of urgency: Those who have analyzed the population trends in the Borders have warned that the area is in danger of losing so many people that it may experience the total demise of many of its com-

munities.(30) With the publication of the White Paper, The Scottish Economy, in 1965, including a section entirely devoted to the "regional" problems of the Borders, much popular concern has become evident and has resulted in many expressions of opinion that some sort of "development" must take place. As one example, the further comment by the Economist reporter referred to in footnote 26 may be quoted.

> "(But) unless the whole of Scotland outside the central industrial belt is to be let go, it makes sense to develop a region where development might actually work. The Central Borders are possibly the best bet."

Thus the intuition repeatedly finds expression that something can happen and something must be made to happen. Otherwise the whole area courts the danger of "being let go", meaning it would revert to a virtually unsettled state and become a lovely but "empty" land. But who would be "letting it go"? Presumably the Borderers themselves are the chief ones involved here, and their popular attitude to the proposed developments appears equivocal. (31) However, the thought that the area may become virtually "empty" appears to provoke an emotional resistance, surprisingly strong outside the Borders, which seems to take the form of an urge to occupy (or re-occupy) the Borders in some viable and visibly permanent way. Even if the territory were to be set aside for recreational purposes, thereby fulfilling a need in an urban society, this emotion would not necessarily subside as the continuing (and, in part, outside) agitation for Highland development illustrates. In both Livingston and the Central Borders operational considerations such as housing and the creation of jobs are important; but there is a distinctive atmosphere of urgency in the Central Borders proposals, reflecting a general alarm that this area may become empty.

It is considered that these diverse points may be related to form an hypothesis which could provide understanding of present developments

beyond that offered in a central place explanation, and therefore to suggest another direction for central place analysis. Thus the hypothesis concerning developmental aspects of the settlement structure in south-east Scotland emerges: classic principles of urban growth are manifest in new proposals for development; motivations behind these proposals betray a fervour in the wider Scottish society for what amounts to the re-colonization of territory (32); the implication is that the close of an era in the history of settlement may be recognized and that a new hierarchical form in the settlement structure may emerge.

(i) Concluding Statement and Summary

This study attempts to document and analyze the contemporary settlement structure of south-east Scotland, focusing the investigation within the framework of Central Place Theory. The particular orientation specifies the analysis of activities only of "working class" people in the countryside as they relate to centres. Functional characterizations of central places are developed accordingly, the only central functions considered being those to which individuals of the general public have direct access.

The specification that a population sub-group is the focus requires that basic premises of Central Place Theory be tested. The results indicate that support is offered by the empirical evidence of this study for the principal features of the theory. A stepped hierarchy is easily observed when central functions are analyzed in relation to central place populations. Directly following from this, typical functional associations for each order of the hierarchy may be identified in the form of trait complexes, and when these are examined for successive hierarchical orders, strong support is indicated for the nesting principle of central functions.

A test of the hypothesis that the functional range, or the "qualitative" characteristics of centres, constitute the principal attractiveness or centrality of places, concludes that a further "quantitative" (or weighting) factor must be applied in order to describe centrality satisfactorily because of the attractive quality of more than one offering (or facility) within one function. The analysis of functional diversity, however, yields the "by-product" result, supporting Berry's contentions concerning metropolitan dominance , that the influence of Edinburgh in the study area is functionally selective, reducing the completeness of functional offerings in centres lying approximately within the "commuting range" of the city.

Throughout all the analyses of centres, a fundamental differentiation is apparent between two groups of centres, identified as Levels A and B. This division is based upon a clearly recognizable tendency for some centres to have high population-per-facility ratios, while others have low ratios. When their distributions are analyzed, it is apparent that they divide the study area into two parts, unequal in size but reflecting the general patterns of relatively high population density and central place population increase as distinct from areas experiencing general population decline, usually from lesser initial densities. Thus the comparisons between Levels are tied in with widening discrepancies among population distributional characteristics.

It has been possible to demonstrate systematically the contact locations for various purposes with centres. These of course vary among activities, but a particular hinterland form, described as the "shot-silk effect" is isolated, and the conditions for its occurrence suggested; overlap among adjacent hinterlands is a standard observation in many studies such as this, but the "effect" describes a particularly extended

form of overlap which might be apparent in other areas under the conditions outlined.

General hinterland delimitations are identified through the procedure of analyzing spatial frequencies of all contacts with centres and then aggregating these into "activity cones" for the Levels and orders of the hierarchy. When these, as general idealized forms, are applied to the specific centres of the study area, they provide a "topographic" surface describing the intensities of aggregate contact with centres; further, their interlocking patterns may be seen to identify very closely, through central place principles, with the actual system of settlement in the area. That is, where activity cones intersect, indicating the point of least hinterland allegiance to centres in the immediate vicinity, another central place may be expected to emerge; this expectation is fulfilled in south-east Scotland. This observation not only indicates the operation of central place principles, it also justifies the particular hierarchical divisions chosen on functional and population grounds; for activity cones are derived from interview information and their magnitude describes the average degree of influence of centres distinguished by order. That this average may be applied to individual component centres and, taken together demonstrate such conformity with central place principles, is striking.

Both being dependent upon population density, centrality and the volume of activity cones should relate very closely. When plotted against each other, they exhibit perfect correlation, thus illustrating the correctness of the characterization of centres and hinterlands (representing different lines of study and data collection) each in terms of the other. The widening gap between the regressions, however, indicates a functional shift within the hierarchy. Level A centres increase the volume of their activity cones at about one half the rate of centrality increase, while Level B

centres do so at close to twice the rate.

In general, and despite differences in scale, the model identified by Berry is found to have application in the study area. However, the apparently greater intricacy of topographic influences in south-east Scotland as compared with Berry's study area of the United States middle west, and the closer proximity of relatively empty uplands to densely settled parts, results in a pattern of association of these lightly populated uplands directly with the major central places, rather than giving rise to their own central places. Thus the "centre-margin" model has conceptual dimensions in this study in addition to the empirical spatial ones defined by Berry; as such, the model becomes more general and applicable.

Growth patterns in the central place settlement of an area are also confirmed, being consistently followed in south-east Scotland. Godlund's characterization of the space-filling process of central place theory ("colonization" of territory) is conservative in that the emergent central place, between two more powerful ones, remains either equal to, or reverts to being less than, the centres in whose contexts it develops. New developments in south-east Scotland suggest the additional stage where the emergent centre grows to dominate other centres, a stage which is possibly accentuated when the surrounding region undergoes considerable population decline.

The general concern for the future prosperity of Scotland has resulted in two major development proposals in the south-east, Livingston and the Central Borders. It is of interest to attempt to account for these new developments in at least a preliminary way because their magnitude and scope portend a key role for them in the future evolution of the settlement pattern. It is possible to place the proposals and the implementation of

them into a central place theoretical framework consistent with the existing pattern of the hierarchy. However, the empirical circumstances are such that a central place explanation passes over motivational elements which may have played a significant part in prompting action, and further, the very implementation of the changes suggests an additional explanation.

The changes in the nature of the hierarchy, implied by such an important shift of focus from traditional burghs to large regional centres, suggest that the end of one era and the start of another are heralded. If, as Carter points out, hierarchies must be studied temporally within the context of an identifiable stage of development, or historical period, the present investigation perhaps may be viewed as documenting conditions at the close of one period and therefore providing a reference base for the future study of another. It is suggested that the direction of such future study might include the considerations that a classic reason for the growth of urban centres, the spatial articulation of inter-regional movement, is being asserted in south-east Scotland's developments; that this differs in process from the traditional local market, defence, industrial, and administrative functions which are responsible for the locational structure of the present hierarchy. Further, what amounts to a group commitment to the area of development is also manifest in the attempts to reverse the general decline, and the extent of this commitment may well have a bearing upon the success of the proposals in their implementation.

IV FOOTNOTES

1. See, for example, Chapter V, "Away from the Complex: cross-cultural patterns", in Berry, B.J.L., Geography of Market Centers and Retail Distribution, Prentice-Hall, Englewood Cliffs, N.J., 1967.

2. The intention of this comment is not to infer McLuhan's "Mechanical Bride" for the people of south-east Scotland; it is merely to note the human tendency to pride in dress, and in motor cars also (although this is considered aggregatively less important), and hence to careful selection of purchases.

3. The same may also be said of hospitals organization. Specifically, Godlund has presented an analysis of hospital regions in Sweden. See "Population, regional hospitals, transport facilities and regions: planning the location of regional hospitals in Sweden", Lund Studies in Geography, Series B, No. 21, 1961.

   Studies concerned with the territorial arrangements for schools organizations include: Ministry of Technology, "Economic Planning of Secondary Schools in West Perthshire", Published by the Industrial Operations Unit, Millbank Tower, London, SW1, September, 1965, 19pp. + xv. Appendices. Also: Yeates, M., "Hinterland Delimitation: a Distance Minimizing Approach", Prof. Geogr., XVI, 1963, pp. 7-10.

4. See Galbraith, op. cit., footnote 18 in section III(b).

5. Berry, B.J.L., "The Impact of Expanding Metropolitan Communities upon the Central Place Hierarchy", Annals, Amer. Assoc. Geogrs., L, 1960, pp. 112-116. Berry indicates that: "Centralization at the metropolitan level may be interpreted as metropolitan dominance, but this type of dominance is only a special case of more general centralization trends occurring throughout the central place system." (pp. 116)

6. It would be desirable at this point to show that those activities in which Edinburgh is strongly represented in the Lothians are in fact those in which the Level A centres near the City are functionally deficient. However, the mesh of the functional classification is not fine enough to permit the demonstration of this relationship. For example, while contacts for clothing purchases are the most widespread and numerous with the City, it is also true that under apparel and drapery goods (Category 3 in the functional classification), the numerous locally-oriented drapers who stock baby clothes and some women's wear, in addition to small drapery goods such as thread and wool, are also logically included. Thus this Category does not necessarily reflect a pattern of notable deficiency in Level A centres of low diversity lying close to the City.

7. Colby, C.C., "Centrifugal and Centripetal Forces in Urban Geography," Annals, Assoc. Amer. Geogrs., XXIII, 1933, pp. 1-20. This article was probably the first to deal with urban developments in the explicit framework of these opposing forces, in the geographical literature. The applicability of the concepts lies not only within the urban centre as Colby used it, but also in distinguishing between central place attraction for people in the countryside (centripetal) and for vans servicing the countryside from centres (centrifugal).

8. Wheeler, P.T., "Travelling Vans and Mobile Shops in Sutherland," Scot. Geog. Mag., LXXVI, 1960, pp. 147-155.
Helle, R., "Retailing in Rural Northern Finland: Particularly by Mobile Shops," Fennia, XCI, N:o 3, 1964, pp. 1-120.
Johnston, R.J., "Central Places and the Settlement Pattern," Annals, Amer. Assoc. Geogrs., LVI, 1966, pp. 541-549. Johnston's study does not deal with mobile shops but shows the relevance of the degree of nucleation in central place analysis, a neglected aspect.His study was set in Yorkshire.

9. Berry, B.J.L., and Wm. Garrison, "A Note on Central Place Theory and the Range of a Good," Ec. Geog., XXXIV, 1958, pp. 304-311. In this paper the authors demonstrate the empirical existence of excess profits, thus countering Lösch's theoretical point that they are impossible because each market area must be as small as possible.

10. Johnston notes in his conclusion that: "...village size and degree of nucleation ... are more important than total population or number of villages in determining the distribution of the elements of social provision." (op.cit., pp. 549)

11. To consider individual centres of slightly varying functional complexities as belonging to the same group is not without precedent. E.N. Thomas develops the theme that a range of population may be identified within which the "same size" of centre may be inferred. In identifying the nearest neighbour of the same size as a centre of 105 persons in Iowa, he thus is able to consider all those centres having between 72 and 159 persons inclusively. See "Toward An Expanded Central Place Model", Geog. Rev., LI, 1961, pp. 400-411.

12. Activity cones are analogous to Lösch's "demand cones" inasmuch as they are an empirical expression of his theoretical derivation. Losch, A., The Economics of Location, Trans. from the second revised edition, of 1943, by Wm. H. Woglom and W.F. Stolper. Science Editions Paperback, 1967, John Wiley and Sons, New York, authorized by the Yale University Press. Chapter 9, "The Market Area", develops the concept of "demand cones"; the theme also outlined in an earlier paper, "The Nature of Economic Regions", Southern Economic Journal, V, No. 1, 1938, pp. 71-78.

13. Boesch, Hans, "Central Functions as a Basis for a Systematic Grouping of Localities", Abstract, in International Geographical Union, Abstracts of Papers, 1952, pp. 7.

Authors who have reviewed work concerning centrality include Davies, W.K.D., "Centrality and the Central Place Hierarchy," Urban Studies, IV, No. 1, 1967, pp. 61-79; and Godlund, S., "The Function and Growth of Bus Traffic within the Sphere of Urban Influence," Lund Studies in Geography, Series B, No. 18, 1956, 80pp.

14. Volumes are measured to the base "contour" level of 0.1 contacts per distance ring. They are divided by 100 to reduce the numbers to a more convenient magnitude for analysis.

15. Meier, R.L., A Communications Theory of Urban Growth, M.I.T. Press, Cambridge, Mass., 1962. Meier takes the quite mechanistic view that

increased proximity and communications are inseparable parts of the same process which is reflected in increased interaction among individuals and groups. The interaction carries the effect of improving communications consciously and hence furthering this spiralling process to the point where media are overloaded, becoming choked with messages and movement, and resulting in a conscious, "voluntary" rationing of their use. Presumably urbanization tapers off at this point.

16. Continuing the example cited in footnote 13 of section III(b), "scholars" tickets are issued by the West Lothian County Council Education Department for use on regularly scheduled S.M.T. buses. Thus the public transport network may be seen to be a closely meshed system sufficient to enable large-scale problems of access to certain points to be accommodated with no special provision.

17. See footnote 17 in section III(b).

18. Scottish Development Department, The Lothians Regional Survey and Plan, HMSO, Edinburgh, 1966; also The Central Borders: A Plan for Expansion, HMSO, Edinburgh, 1968.

19. Berry, op.cit., footnote 1. See Chapter II, "Systematic Variations of the Hierarchy".

    Godlund, op.cit., footnote 13. See Chapter V, "Traffic, Umlands, and Built-up Areas. Prognosis and Recommendations".

20. Barnum, in his study in Baden-Württemberg, finds that his results are directly comparable with Berry's in the United States. However, he conducts his study within the same framework as Berry, and therefore collects exactly comparable data.

21. See footnotes 3 and 4 in section II(e).

22. The influence of Berwick-on-Tweed is, of course, considerable in the Merse, as the contact location maps in this study indicate. However, Duns lies farther from Berwick than Innerleithen does from Galashiels on a straight line measure, and lies right at the edge (10 contacts per distance ring) of Berwick's activity cone should the latter be considered equal to a fifth order centre in this study. Further, Duns, as the political centre of Berwickshire, gains stature as a central place beyond the mere addition of facilities, and is thus the most important, if lower order centre, in the area apart from Berwick.

23. Scottish Development Department, op.cit., footnote 18.

24. The estimates for Livingston's projected population have varied, but a figure of 100,000 people is a rough guide. In the Central Borders the Plan calls for the attraction of some 25,000 people to the area.

25. Quotations from Paragraph 113 of The Central Borders, op.cit., footnote 18.

26. Op.cit., footnote 12 in section II(c). Further, in an article called

"A borderline case", published in the Economist of December 30, 1967, the following was reported:

> "When the Darnick pilot scheme, for a new development of about 1,000 people, was confirmed by the Roxburgh County Council earlier this year, all kinds of people started to object. Some of them talked sense: most just wanted a quiet life. Last month, the Secretary of State for Scotland announced that the objectors had lost...
> "If a Town Council can be bothered, Kelso's example shows that it is entirely possible to entice a few firms to a Border town, and start a mild expansion, without central government intervention. If the locals do not want to be bothered to attract industry, there is after all quite a case for just letting them decline."

27. Carter, Harold, "The Urban Hierarchy and Historical Geography: A Consideration with Reference to North-east Wales," Geographical Studies, III, 1956, see pp. 87.

28. R.E. Dickinson pertinently comments:

> "Indeed, with a few exceptions, the chief towns at the beginning of the nineteenth century were situated at the junction of the main road and water routes, and these towns and routes almost all date back in origin to the early Middle Ages. Long distance trade was the primary factor in the development of the early medieval towns."

Quotation taken from "The Scope and Status of Urban Geography: An Assessment," Land Economics, XXIV, 1948, pp. 221-238. Reprinted in Readings in Urban Geography, edited by H.M. Mayer and C.F. Kohn, University of Chicago Press, 1959.

29. See Map 20, pp. 86-97 in The Central Borders, op. cit., footnote 18.

30. Scholarly reports usually emphasize facts and trends in their analyses. Political documents are probably better at portraying warning in a more urgent atmosphere. One such is the Liberal Party pamphlet Boost for the Borders, A Liberal Plan for the Development of the Border Counties of Scotland, prepared by a Committee under the Chairmanship of David Steel. (No date is given but it was probably published in 1964.) In this political document, a 1948 statement by Sir Frank Mears is quoted: "... the disintegration of rural life caused by that isolation (of the Borders from large centres) has caused a drift of the younger people to Edinburgh, England and overseas until a point has been reached where further emigration will mean the extinction of the traditional Border life." This quotation is followed immediately by the atmosphere-building statement: "Seventeen years later nothing whatever has been done to stop emigration, and the extinction of Border life has moved remorselessly closer to reality." (pp. 17)

31. Sometimes the writer received the impression that the excitement regarding Borders "development" reaches a greater pitch outside the area than it does within. There was certainly no unanimous acclaim, among various County officials and others whom the writer spoke to, for the proposals.

32. The idea of "colonization" is a persistent one in central place study because it describes the process of "space-filling" which, in a market sense, the theory tries to explain. In a recent reconstruction of Lösch's idealized development of central places, where, as in Godlund's model, the areas of market are successively reduced to a point of saturation of the whole region, Haggett employs the very term "colonization" in a caption to describe the evolution of the hexagonal cellular structure as the point of saturation is approached. His use of the term is in the tradition of classical central place theory, however, rather than in the sense employed here as illustrated by the popular term "jumping-off point". See "Network Models in Geography", Chapter 15, Models in Geography, 1967, Methuen, London, pp. 649. Also see Lösch, op. cit., footnote 12, pp. 110. Walter Isard introduces Location and Space Economy, John Wiley and Sons, New York, 1956, with an hypothetical narrative of the colonization process in an area being entered and settled for the first time by a group of people.

APPENDICES

APPENDIX A

The Questionnaire

N.G. _____ B.

Type of purchase OR type of van	Town from which van comes OR town to which visits are paid for item	How often van calls OR frequency of visit to town for item	Shop which sends van OR shop where purchase usually is made	Further remark
butcher	1 2			
fish	1 2			
milk				
grocer	1 2			
bake goods	1 2			
clothing -men -women -child				
hardware				
cleaners				

1. _____ Where do you hire, or did you buy, T.V.?
2. _____ If you have a motor car, where did you buy it?
   _____ Where do you usually buy petrol?
   _____ Where do you usually have your car serviced?
3. _____ Where do you go to a doctor?
4. _____ Where do you go to a dentist?
5. _____ Where do you go to a chemist?

6. _____ If you use a bank, where do you go to it? (Name of town)

_____ What kind of bank is it? (P.O. Savings, or any other)

7. _____ If anyone in the household draws a government pension, where does he/she go to draw it?

8. _____ Where would you go to buy postage stamps or to post a parcel? (Name of Post Office

9. _____ To what church do you belong?

_____ Where is it?

10. _____ If you go to a pub, where do you go?

11. _____ How many persons are there in the household?

_____ What are their ages?

_____

12. _____ Where do members of the household work?

_____

_____

13. _____ What newspapers do you take? (Daily and Weekly)

_____

14. _____ How often do you go to Edinburgh?

_____ Why?

15. _____ How often do you go to Glasgow?

_____ Why?

16. _____ How often do you go to Newcastle-on-Tyne?

_____ Why?

17. Weekly food expenditure for the household. Circle one.

under £2; £2 to 3; £3 to 4; £4 to 5; £5 to 7; £7 to 10;

£10 to 12; £12 to 15; over £15.

APPENDIX B

Mapping Procedures

1. The Selection of Isopleth Intervals

The method of mapping distributions by isopleths, as employed in this study, is outlined in Chapter I(c). This Appendix presents the histograms by which isopleth intervals are selected.

The point of view adopted with regard to the plotting of data on maps is that it is less important to have regular intervals than it is to show significant groupings of data. In order to define intervals describing such groupings, data are first plotted on frequency histograms. Second, running averages are calculated for two adjacent columns in the histogram and re-plotted, this time on semi-log paper which allows the rates of change of data frequency to be observed. The steepness of the slopes may be compared to judge comparatively greater or lesser rates of change. Important groupings of data are defined to be those separated from other groupings by troughs in the trend of the frequency distribution. Selection of groups is by inspection.

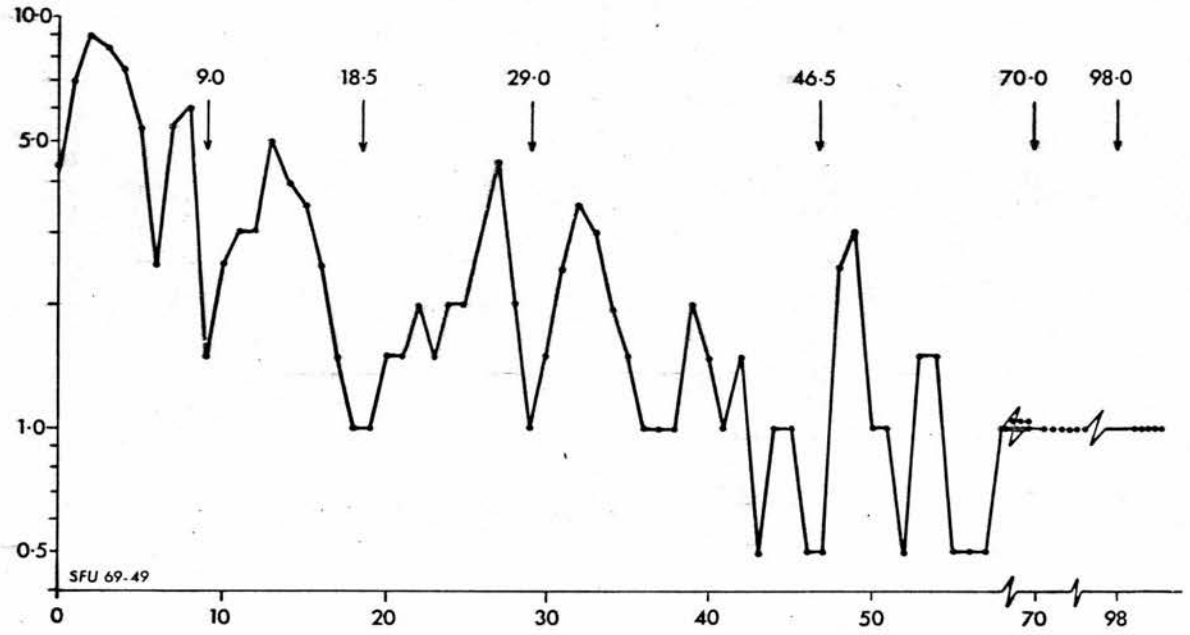
In most cases the troughs selected represent isopleth values on maps; where they do not, the reason is usually that the value is too small to be of significance or use on the map. In such cases, details are outlined in the text in the course of discussion. Histograms are constructed by entering the values recorded at the centre of control areas. Values on the periphery of the study area are used only if the control area lies wholly within the study area boundary; thus problems of distortion due to a possible lack of data in control areas are eliminated.

2. A Note on Map 5, Employment Structure, Mid-1964

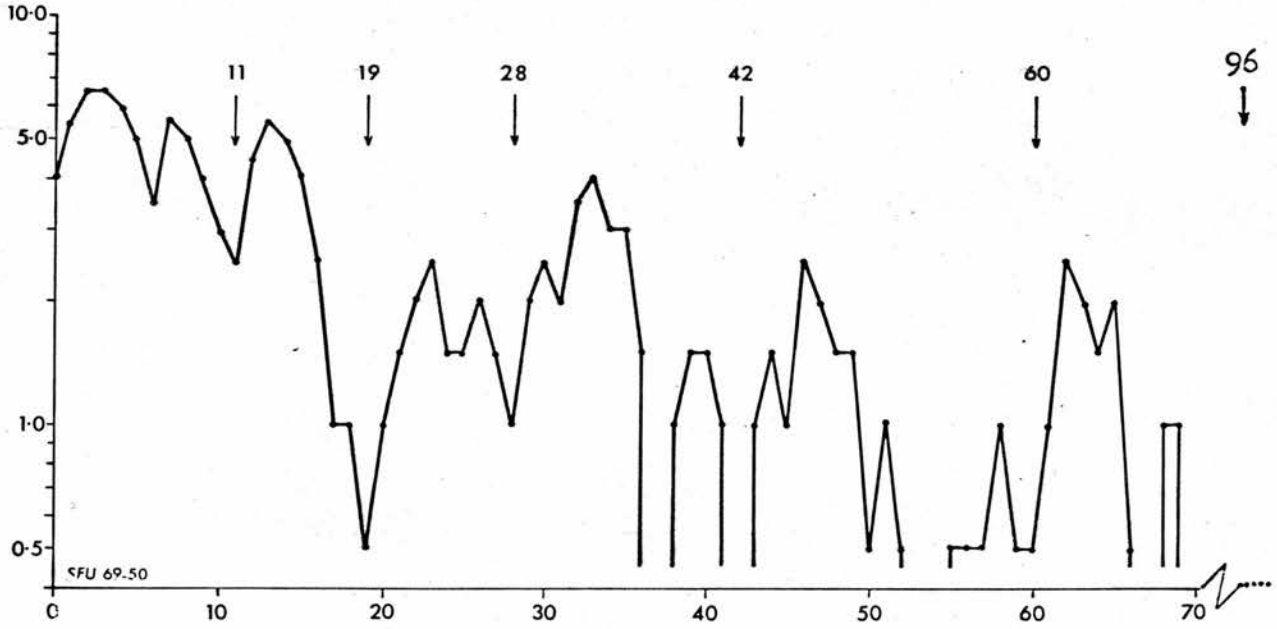
In conducting research into reader-perception of maps, Professor Flannery has found that smaller circles on maps are overestimated consistently relative to the larger ones. This finding is particularly relevant where proportional circles are employed to describe distributions. The following procedure was developed to correct this apparent "distortion" and is employed in the construction of Map 5. The procedure is outlined by Professor Robinson in Elements of Cartography, 2nd edition, 1964, pp. 163-165.

1. Take the logarithms of the data (employment figures here).
2. Multiply the logarithms by 0.57.
3. Take the anti-logarithms of the products.
4. Convert the anti-logarithms to radii at a convenient scale for mapping.

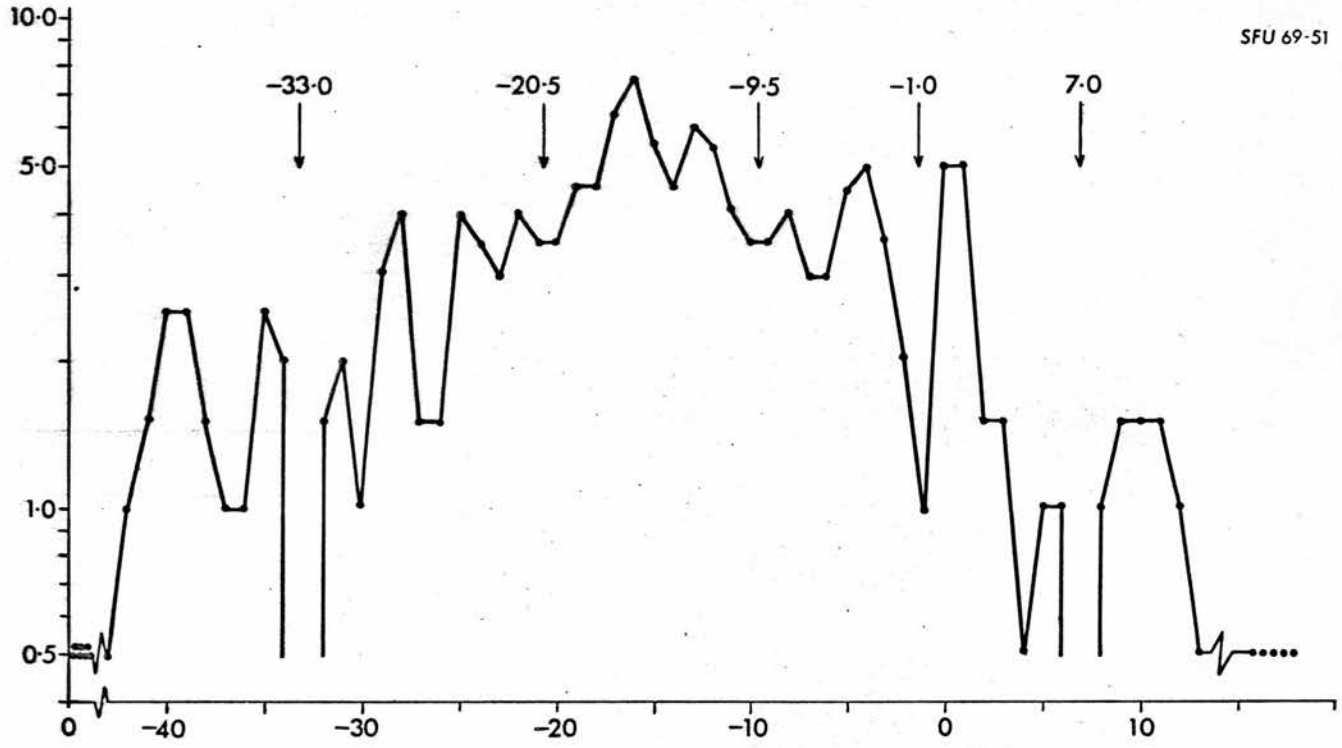
The effect of this procedure is to reduce the smaller circles relative to larger ones. "The square root of log n = $\frac{\log n}{2}$ or log n X 0.5. Multiplying the logarithms by 0.57 instead of 0.5 serves proportionately to increase somewhat the sizes of the larger circles so that they appear in the proper relation to the smaller ones."(pp. 164) The critical point here is that larger values, when multiplied by a constant, yield increasingly larger products. Thus Edinburgh's characterization and those of the centres specifically studied here, are apparently true in their interrelationships in Map 5.



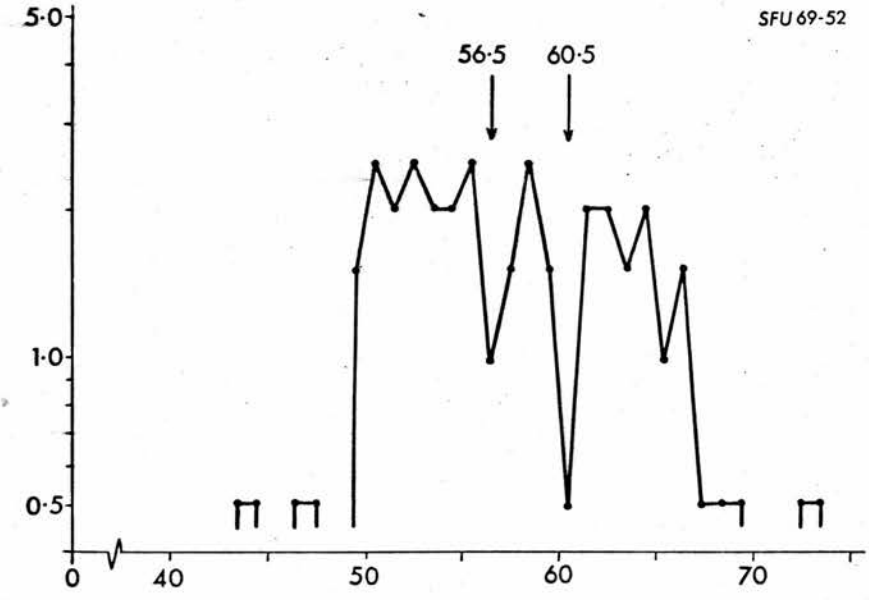
Selection of Isopleth Intervals for Map2: Population Distribution and Density, 1961



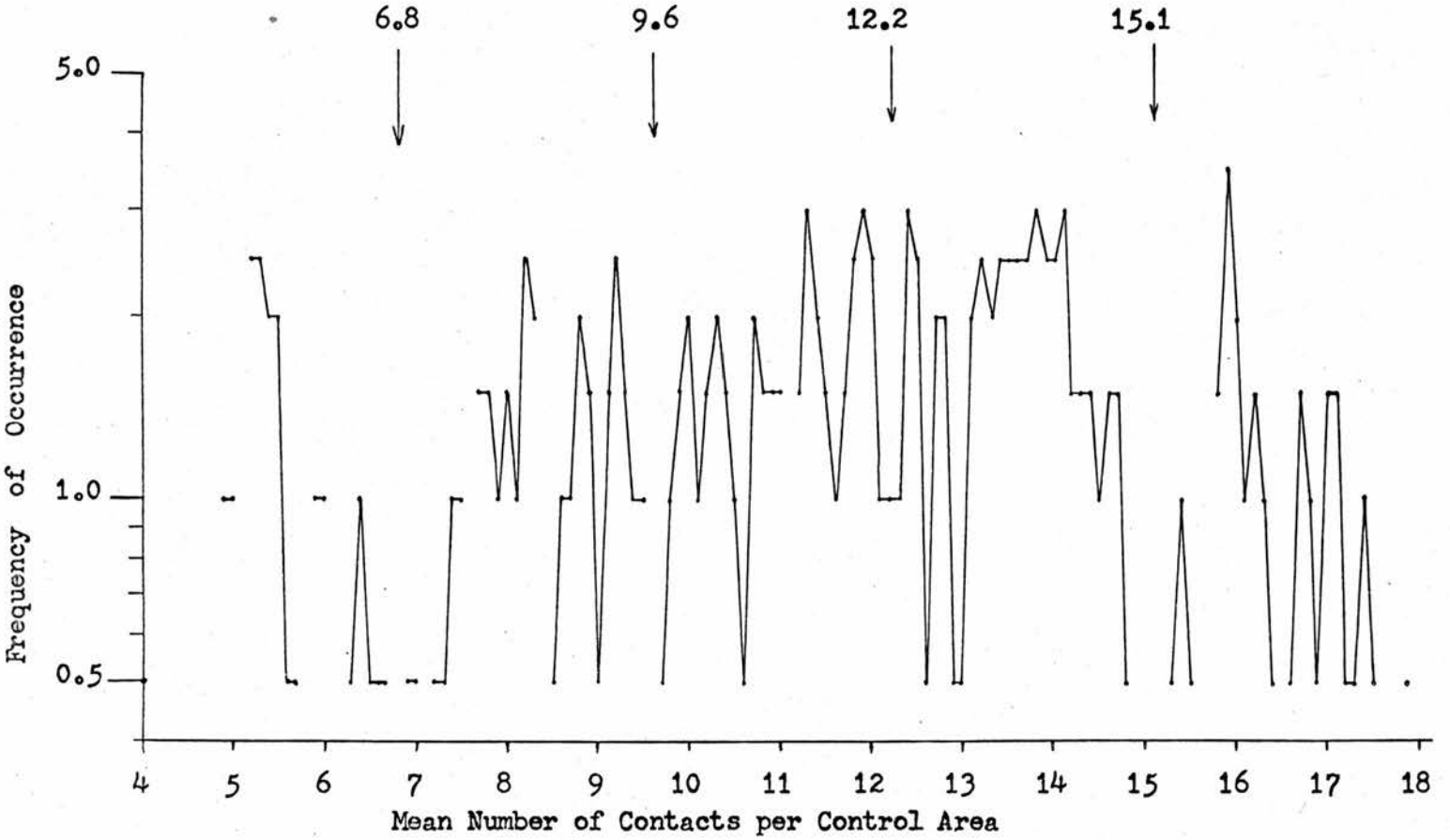
Selection of Isopleth Intervals for Map 3: Population Distribution and Density, 1951



Selection of Isopleth Intervals for Map 4: Percentage Population Change, 1951 - 61

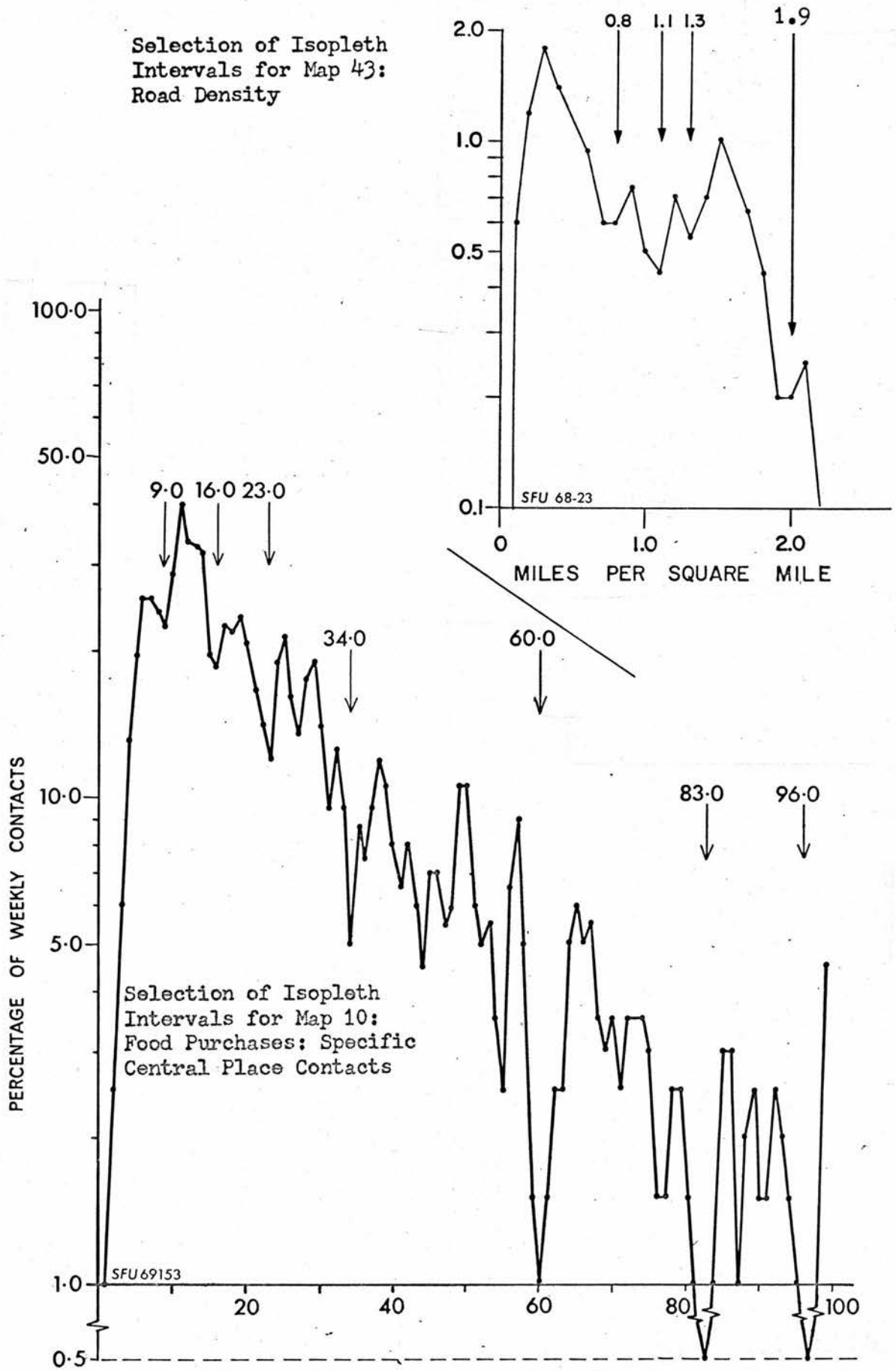


Divisions of Centres Based on the Shear Index of Diversity (Map 7)



Selection of Isopleth Intervals for Map 9: Food Purchases - Total Weekly Contacts

Note: Thirty control areas have zero values recorded and three others have values between zero and three.


Selection of Isopleth Intervals for Map 43: Road Density
2.0
1.0
0.5
0.1
0.8
1.1
1.3
1.9
SFU 68-23
0
1.0
2.0
MILES PER SQUARE MILE
100·0
50·0
10·0
5·0
1·0
0·5
9·0
16·0
23·0
34·0
60·0
83·0
96·0
PERCENTAGE OF WEEKLY CONTACTS
Selection of Isopleth Intervals for Map 10: Food Purchases: Specific Central Place Contacts
SFU 69153
20
40
60
80
100

APPENDIX C

List of Centres in South-east Scotland

LIST OF CENTRES IN SOUTH-EAST SCOTLAND

Population and Functional Facilities Shown

CENTRE	Population/1961	No. of Facilities	Ratio Pop./Fac.
FIRST ORDER			
Abbey St. Bathans	51	3	17
Abercorn	21	2	11
Allanton	116	8	15
Appletreehall	35	2	18
Ashkirk	99	7	14
Athelstaneford	203	6	34
Auchencrow	31	6	5
Auchendinny	372	5	74
(by) Ballencreiff	100	1	100
Bedrule	38	2	19
Bellsquarry	204	5	41
Birgham	118	5	24
Blackness	150	6	25
Blainslie	24	2	12
Blyth Bridge	55	6	9
Boggs/Newtown	186	2	93
Bolton	52	2	26
Bonchester Br.	209	10	21
Borthwick/North Middleton	233	7	33
Bowden	171	5	34
Bowland	24	1	24
Bunkle	---	1	--
Burnmouth	281	8	35
Burnside	25	1	25
Cappercleuch/Megget	---	7	--
Carfraemill	---	3	--
Carlops	61	7	9
Carrington	106	5	21
Cavers	74	1	74
Caverton Mill	39	1	39
Chesters	54	5	11
Clappers	74	3	25
Clovenfords/Caddonfoot	197	10	20
Cockpen	22	2	11
Cogsmill/Stobs	---	1	--
(by) Congalton	---	1	--
Cousland	172	4	43
Cove	37	1	37
Crailing/Nisbet	100	4	25
Cranshaws	25	4	6
Cranston	20	3	7
Crichton	46	1	46
Crossgatehall	---	2	--
Crossroads	---	2	--
Damhead	127	1	127
Drem	95	2	48
Drumelzier	26	2	13
Dryburgh	49	4	12
East Barns	30	1	30
East Saltoun	173	6	29
Eccles	84	7	12
Ecclesmachan	83	2	42
Eckford	23	4	6
Eddleston	181	8	23
Edgehead	112	4	28

CENTRE	Population/1961	No. of Facilities	Ratio Pop./Fac.
Edgerston/ Camptown	29	5	6
Ednam	140	3	47
Edrom	58	4	15
Ettrick	38	5	8
Ettrickbridge End	69	10	7
Fala	45	8	6
Fogo	30	1	30
Foulden	208	6	35
Fountainhall	136	6	23
Garvald	69	7	10
Gattonside	364	5	73
Gavinton	149	6	25
Gladsmuir	92	5	18
Glen	57	2	29
Glen Douglas	---	1	--
Grantshouse	135	13	10
Hallyne	10	2	5
Harburn	23	1	23
Heiton	110	5	22
Heriot	77	12	6
Hermiston	87	4	22
Hermitage	---	1	--
(by) Hoselaw	---	1	--
Houndslow	21	1	21
Houndwood	30	1	30
Howgate	55	6	9
Hownam	21	3	7
Humbie	68	5	14
Hume	46	3	15
Hutton	80	5	16
Innerwick	155	8	20
Kingside	11	1	11
Kingston	148	1	148
Kirkburn	---	1	--
Kirkton	41	1	41
Ladykirk	31	3	10
Lamancha/ Cowdenburn	50	4	13
Langshaw	---	1	--
Lanton	71	2	36
Legerwood/ Kirkhill	59	2	30
Leitholm	161	10	16
Lempitlaw	25	1	25
Lindean	94	1	94
Lintlaw	48	1	48
Linton	44	1	44
Livingston	126	10	13
Longformacus	84	7	12
Longnewton	41	1	41
Longyester	30	1	30
Makerstoun/ Manorhill	65	4	16
Manor/Kirkton	45	4	11
Maxton	71	5	14
Mellerstain	80	1	80
Mertoun/Clint Mains	102	4	26
Midlem	79	4	20
Millburn	---	1	--
Millerhill	112	5	22
Milton Bridge	91	10	9
Minto	51	3	17
Morham	30	3	10
Nenthorn	33	4	8
Newbattle	93	1	93
Newmill-on-Teviot	42	4	11
Newstead	165	3	55
Newton (by Danderhall)	371	4	93
Newton (by Woodend)	175	8	22
Newtonloan	37	7	5
Oakbank	149	5	30
Old Cambus	4	1	4
Old Craighall	110	2	55
Oldhamstocks	47	4	12
Oxnam	38	4	10
Oxton	122	13	9
Paxton	187	11	17
Pleasants	---	1	--
Polton	132	3	44

CENTRE	Population/1961	No. of Facilities	Ratio Pop./Fac.
Polwarth	44	2	22
Preston	68	1	68
Pyatshaws	---	1	--
Rachan	73	1	73
Redpath	50	2	25
Riccarton Jn.	62	3	21
Roberton	47	4	12
Romanno Bridge	51	8	6
Roxburgh	105	4	26
St. Abbs	233	9	26
Sandystones	24	1	24
Saughtree	26	2	13
Seafield (by Damhead)	57	1	57
Silverburn	50	3	17
Sinclair's Hill	33	1	33
Skirling	145	7	21
Smailholm	61	4	15
Spott	36	3	12
Sprouston	116	4	24
Stenton	114	9	13
Stichill	86	4	22
Stobo	89	5	18
Temple	102	8	13
Teviothead	30	4	8
Towford	---	2	--
Toxside	27	1	27
Traquair	66	5	13
Tweedsmuir	66	5	13
Tynehead	28	1	28
Tyninghame	138	2	69
Westfield	351	5	70
Westruther	51	6	9
West Saltoun	26	1	26
Whitekirk	100	5	20
Whitsome	58	6	10
Whittingehame	83	4	21
Wilkieston	241	3	80
Woodend	18	2	9
Yarrow	32	1	32
Yarrowfeus	55	3	18
Yarrowford	41	2	21

CENTRE	Population/1961	No. of Facilities	Ratio Pop./Fac.
SECOND ORDER			
LEVEL A			
Aberlady	641	18	36
Addiewell and Loganlea	1,659	18	92
Bilston	1,311	14	94
Blackridge	1,764	27	65
Breich	430	9	48
Bridgend	1,020	13	78
Dalmeny	608	7	87
Danderhall	2,523	22	115
Dechmont	534	10	53
Dirleton	693	17	41
East Calder	2,120	40	53
East Whitburn	669	7	96
Elphinstone	555	8	69
Kirkliston	1,249	24	52
Kirknewton	622	15	41
Livingston Sta.	1,365	19	72
Longridge	504	12	42
Macmerry	1,075	20	54
Ormiston	1,922	37	52
Pencaitland	617	17	36
Philpstoun	352	11	32
Polbeth	1,850	19	97
Pumpherston	1,458	21	69
Ratho	1,011	21	48
Ratho Station	740	10	74
Rosewell	1,860	34	55
Seafield	1,028	9	114
Stoneyburn	2,487	38	65
Torphichen	468	11	43
Uphall	2,372	46	52
Uphall Station	983	8	123
Walkerburn	869	20	43
Wallyford	2,445	30	82
Whitecraigs	1,524	17	90
Winchburgh	2,457	34	72

CENTRE	Population/1961	No.of Facilities	Ratio Pop./Fac.
SECOND ORDER			
LEVEL B			
Ancrum	338	15	22
Ayton	425	40	11
Balerno	919	34	27
Broughton	192	20	10
Chirnside	821	35	23
Cockburnspath	277	17	16
Coldingham	392	30	13
Denholm	581	26	22
Earlston	1,367	54	25
East Linton	925	49	19
Gifford	474	24	20
Gordon	362	18	20
Greenlaw	557	36	15
Gullane	1,634	61	27
Lauder	615	49	13
Lilliesleaf	233	18	13
Longniddry	894	29	31
Mid Calder	633	40	16
Morebattle	228	17	13
Newbridge	433	15	29
Newcastleton	927	43	22
Newtown St. Boswells	1,052	36	29
Pathhead	951	31	31
Reston	361	27	13
Roslin	1,146	38	30
St. Boswells	1,007	50	20
Stow	453	27	17
Swinton	266	16	17
West Linton	730	47	16
Yetholm	552	24	23
THIRD ORDER			
LEVEL A			
Blackburn	4,329	45	96
Cockenzie and Port Seton	3,461	66	52
Currie	4,142	57	73
Easthouses	6,510	52	125
Fauldhouse	4,714	65	72
Newtongrange	4,964	69	72
South Q'ferry	2,948	66	45
LEVEL B			
Coldstream	1,226	88	14
Duns	1,837	132	14
Eyemouth	2,161	74	29
Innerleithen	2,299	80	29
Melrose	2,133	99	22
West Calder	1,535	101	15
FOURTH ORDER			
LEVEL A			
Armadale	8,214	115	71
Bonnyrigg and Lasswade	9,629	169	57
Broxburn	6,775	139	49
Gorebridge	7,812	101	77
Loanhead	5,020	110	46
Penicuik	7,253	157	46
Prestonpans	8,021	102	79
Tranent	6,844	159	43
Whitburn	5,904	99	60
LEVEL B			
Dunbar	4,589	192	24
Haddington	5,652	234	24
Jedburgh	3,645	146	25
Kelso	3,968	185	21
Linlithgow	5,154	159	32
North Berwick	4,161	202	21
Peebles	5,548	203	27

CENTRE	Population/1961	No. of Facilities	Ratio Pop./Fac.
Selkirk	5,634	171	33
FIFTH ORDER			
LEVEL A			
Bathgate	12,945	305	42
Bo'ness	12,029	201	60
Musselburgh	17,796	387	46
LEVEL B			
Dalkeith	8,955	282	32
Galashiels	12,373	365	34
Hawick	16,516	451	37

APPENDIX D

Functional Classification for Settlements in South-east Scotland

FUNCTIONAL CLASSIFICATION FOR SETTLEMENTS IN SOUTH-EAST SCOTLAND

I Retail

1. Food

(a) General shops, grocers, provision dealers, and dairies

- dairymen
- general dealers
- general merchants
- grocers
- provision merchants
- wine and spirit merchants (but not public houses)

(b) Butchers

- butchers
- pork butchers

(c) Fishmongers, poulterers

- fishmongers, game and poultry dealers
- poulterers

(d) Greengrocers and fruiterers

- fruit merchants
- fruiterers and greengrocers

(e) Bread and flour confectioners

- bakers

2. Confectioners, tobacconists, and newsagents

- confectioners
- newsagents and vendors
- tobacconists

3. Apparel and drapery goods

- baby linen
- boot and shoe factors, and warehousemen
- boot and shoe shops
- children's outfitters
- clog makers
- clothiers
- costumiers
- drapers
- dressmakers
- gowns
- knitwear (retail)
- milliners
- outfitters
- outfitters - ladies
- tailors
- tartans
- wool shops

4. Hardware

- china, glass, and earthenware
- drysalters
- grate and range builders
- hardware merchants and dealers
- ironmongers

5. Electrical goods and household appliances

- domestic appliances
- electrical power supplies undertakings
- engineers - radio and television
- gas supply (show rooms)

5. Electrical goods and household appliances (continued)

- radio relay services
- radio suppliers - retail
- sewing machine manufacturing and merchants
- television
- television aerials
- vacuum cleaner makers and dealers
- washing machine makers and dealers

6. Booksellers and stationers

- booksellers
- printers and stationers
- stationers
- typewriter manufacturing and dealers

7. Chemists and photographic goods

- chemists
- photographic apparatus dealers

8. Cycles and cycle accessories

- baby carriages
- cycle agents and dealers
- motor cycles

9. Furniture and music

- antique and curio dealers
- cabinet makers
- furnishers
- furniture dealers
- house furnishers
- linoleum and floorcloth
- music sellers and instrument dealers
- wallpaper merchants

10. Jewellers, leather, sports and fancy goods

- fancy goods - importers and dealers

10. Jewellers, leather, sports and fancy goods (continued)

- fishing tackle
- golf club makers
- gun, rifle and pistol makers
- jewellers
- leather factors and merchants
- saddlers and harness makers
- sports outfitters
- tanners and curriers (if a shop as in 2 out of 3)
- watch and clock makers

11. Department and variety stores

12. Household fuel merchants

- coal and coke merchants
- firewood

13. Other retail

- florists
- handicrafts
- pet stores and dog grooming
- woodworker's supplies

II <u>Services</u>

14. Restaurants, cafes, hotels, public houses, and roadhouses

- cafe proprietors
- caterers
- fish restaurants
- hotels - (pubs)
- hydropathic establishments
- ice cream manufacturers
- ice cream merchants
- restaurants
- roadhouses

15. Personal services

- boot and shoe repairs
- carpet cleaners and beaters
- cleaners
- commission agents
- dyers and cleaners
- hairdressers
- hairdressers - ladies
- invisible repairers
- laundries - self-service
- laundries
- pawnbrokers
- tourist agents
- upholsterers
- valet service

16. Building trades and materials; household and property maintenance

- builders and contractors
- chimney sweeps
- contractors
- electrical contractors
- electricians
- electrical engineers
- heating and ventilating engineers
- flooring contractors
- glaziers
- heating contractors
- joiners
- joiners and builders
- painters and decorators
- plasterers
- plumbers, electricians, and gasfitters
- roofing contractors
- slaters
- slaters and plasterers
- window cleaners

17. Public assembly halls; entertainment centres

- clubs
- dancing
- entertainments - 2 racecourses
- greyhound racing
- picture houses
- public halls (including "village" halls)
- sports clubs
- theatres and music halls

18. Motor trade establishments

- agricultural implements - (where a motor trade is included)
- auto electrical engineers
- coach builders
- coach painters
- engineers - agricultural (where a motor trade is included)
- motor body builders
- motor car body accessories factors
- motor car agents and dealers
- motor car body repairers
- motor car repairers
- motor and carriage hirers
- motor coach hirers - (where garage, etc. is part of the business)
- motor driving tuition
- motor engineers
- motor garages
- panel beaters
- petrol filling stations
- self-drive hire
- taxi and private hire
- tire factors
- tire retreaders and repairers

19. Medical, health, and social services

- ambulances
- chiropodists
- dental surgeons
- hospitals, dispensaries, etc.

19. Medical, health, and social services (Continued)

- massage treatment
- nurses (public health)
- opticians
- physicians and surgeons (G.P.'s)
- physiotherapists
- social services

20. Professional services other than medical

- architects
- auctioneers and valuers
- funeral directors
- photographers
- photographers - commercial
- property agents (includes estate agents and house factors)
- sculptors
- solicitors
- surveyors
- veterinary surgeons

21. Educational and religious institutions

- schools, colleges, etc.
- schools - nursery
- schools - technical
- local authority schools
- churches

22. Offices of local government, public administration, and law enforcement

- employment agencies (all are M.O.L. offices)
- town, county and district council offices
- post offices

22. Offices of local government, public administration, and law enforcement (Continued)

- police stations

23. Financial institutions and services

- accountant
- banks
- building societies
- hire purchase companies and financiers
- insurance agents
- insurance brokers
- insurance companies
- motor insurance

24. News services

- news agencies
- newspapers and periodicals

APPENDIX E

Functional Characteristics of Centres

THE FUNCTIONAL CHARACTERISTICS OF FIRST ORDER CENTRES

Column Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
Functions / Centres (N=172)	Hall	General	P.O./General Post Office	Kirk	School	Garage	Inn/Pub	Joiner	Police	Medical Services	Coal/Coke	Misc.	Draper	Bank	Baker	Cafe	Insurance Agent	Contractor	Hardware	TOTAL	
Abbey St. Bathans	1			1	1																3
Abercorn					1	1															2
Allanton	1	1		1			1	1	1	1				1							8
Appletreehall	1	1																			2
Ashkirk	1		1		1	1	1			1			1								7
Athelstaneford	1	1		1	1	1			1												6
Auchencrow	1	1		1		1	1	1													6
Auchendinny	2	2						1													5
Ballencrieff by Bathgate		1																			1
Bedrule	1					1															2
Bellsquarry	1	1	1			1		1													5
Birgham	1	1	1					1	1												5
Blackness	2	1		1		1		1													6
Blainslie	1					1															2
Blyth Bridge/ Kirkurd			1		1	1	1		1								1				6
Boggs/Newtown	1	1																			2
Bolton					1	1															2
Bonchester Bridge/ Hobkirk	1	1	1		1	1	3	1			1										10
Borthwick/North Middleton	1	1		1	1	1											1		1		7
Bowden	1		1		1		1		1												5
Bowland	1																				1
Bunkle						1															1
Burnmouth		1	1		1	1	2	1	1												8
Burnside (by Threemiletown)				1																	1
Cappercleuch/ Meggett	1	1		1	1	1	1	1													7
Carfraemill							1	1	1												3
Carlops		1		1	1		1	1	2												7
Carrington	1	1		1	1	1															5
Cavers					1																1
Caverton Mill	1																				1
Chesters	1		1		1	1	1														5

Column Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
Clappers/ Mordington	1	1			1																3
Clovenfords/ Caddonfoot	2	2		1	1	1	1	1						1							10
Cockpen					1	1															2
Cogsmill/Stobs	1																				1
by Congalton		1																			1
Cousland	1	1		1		1															4
Cove		1																			1
Crailing/Nisbet	1			1	1	1															4
Cranshaws	1			1	1	1															4
Cranstoun	1				1	1															3
Crichton					1																1
Crossgatehall	1									1											2
Crossroads by Peaston						1			1												2
Damhead	1																				1
Drem			1						1												2
Drumelzier	1				1																2
Dryburgh			1					1					1	1							4
East Barns						1															1
East Saltoun	1	1	1		1	1	1														6
Eccles	2		1		1	1	1		1												7
Ecclesmachan	1				1																2
Eckford	1			1	1				1												4
Eddleston	1	1	1		1	1	1	1		1											8
Edgehead	2	1							1												4
Edgerston/ Camptown	1			1	1		1	1													5
Ednam				1	1	1															3
Edrom	1			1	1	1															4
Ettrick	1		1		1	1	1														5
Ettrickbridge End	1	1		1	1	1	2	1	1		1										10
Fala	2		1		1	1	1	1	1												8
Fogo					1																1
Foulden	1	1	1		1	1			1												6
Fountainhall	1	1		1		1	1		1												6
Garvald	1	1		1	1	1		1		1											7
Gattonside	1		1				1						2								5
Gavinton	1	1		1	1				1							1					6
Gladsmuir	1			1	1		1		1												5
Glen	1			1																	2
Glendouglas						1															1
Grantshouse	1	1	1		1	1	2	2	1			1			1			1			13
Hallyne					1		1														2
Harburn	1																				1
Heiton	1			1		1	1		1												5
Heriot	2	1	1		1	1	2		1	1	1				1						12
Hermiston	1			1			1		1												4
Hermitage	1																				1

Column Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
by Hoselaw					1																1
Houndslow																				1	1
Houndwood					1																1
Howgate	1	1			1	1		1					1								6
Hownam	1		1		1																3
Humbie	1		1		1	1	1														5
Hume	1		1			1															3
Hutton	1	1		1	1	1															5
Innerwick	1	1		1	1	1						2				1					8
Kingside						1															1
Kingston						1															1
Kirkburn					1																1
Kirkton					1																1
Ladykirk	1			1	1																3
Lamancha/ Cowdenburn			1			1	1	1													4
Langshaw	1																				1
Lanton	1			1																	2
Legerwood/ Kirkhill	1				1																2
Leitholm	1	1	1		1	1	2	1	1		1										10
Lempitlaw			1																		1
Lindean	1																				1
Lintlaw						1															1
Linton					1																1
Livingston	1	2	1		1			2	1	1	1										10
Longformacus	1	1		1	1	1	1	1													7
Longnewton									1												1
Longyester						1															1
Makerstoun/ Manorhill	1			1	1	1															4
Manor/Kirkton	1		1		1	1															4
Maxton	1	1	1		1				1												5
Mellerstain	1																				1
Mertoun/Clint Mains	1				1	1	1														4
Midlem	1		1						1						1						4
Millburn						1															1
Millerhill	1	1					1	2													5
Milton Bridge	1	2		1		1		1	1	1	2										10
Minto	1				1				1												3
Morham	1				1	1															3
Nenthorn	1			1	1	1															4
Newbattle					1																1
Newmill-on-Teviot	1		1			1			1												4
Newstead	1			1					1												3
Newton by Danderhall					1		1	1								1					4
Newton by Woodend	1	3	1				2	1													8
Newtonloan		1			1		4		1												7
Oakbank	2	1		1		1															5

Column Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
Old Cambus	1																				1
Old Craighall							1			1											2
Oldhamstocks	1		1		1	1															4
Oxnam	1			1	1	1															4
Oxton	1	4		1	1	1		1	1	1	1	1									13
Paxton	1	2		1	1	1	1	2	1	1											11
Pleasants						1															1
Polton	1	1		1																	3
Polwarth					1								1								2
Preston	1																				1
Pyatshaw						1															1
Rachan	1																				1
Redpath	1	1																			2
Riccarton Junction	1	1		1																	3
Roberton	1			1	1	1															4
Romanno Bridge/ Newlands	1	1	1		1	1	2	1													8
Roxburgh	1			1	1	1															4
St. Abbs	1	1		1	1	1		1					1	1	1						9
Sandystones						1															1
Saughtree	1				1																2
Seafield by Damhead										1											1
Silverburn	1									1		1									3
Sinclairs Hill	1																				1
Skirling	1	1		1	1	1	1		1												7
Smailholm	1			1	1	1															4
Spott	1				1	1															3
Sprouston	1			1	1	1															4
Stenton	2	1		1	1	1	1	1	1												9
Stichill	2			1	1																4
Stobo	1		1		1	1	1														5
Temple	2	1	1		1	1						2									8
Teviothead	1			1	1	1															4
Towford	1					1															2
Toxside	1																				1
Traquair	2		1		1	1															5
Tweedsmuir	1		1		1	1		1													5
Tynehead				1																	1
Tyninghame			1						1												2
Westfield	1	1		1	1	1															5
Westruther	1		1		1	1		1			1										6
West Saltoun		1																			1
Whitekirk	2		1		1	1															5
Whitsome	1			1	1	1										1		1			6
Whittingehame	1			1	1	1															4
Wilkieston		1		1	1																3
Woodend	1											1									2

Column Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
Yarrow					1																1
Yarrowfeus	1			1		1															3
Yarrowford	1		1																		2
TOTAL	135	66	40	56	95	89	54	39	39	13	9	8	7	5	4	4	2	2	1	1	669
PERCENTAGE OF CENTRES WITH FACILITY	77.8	38.4	23.2	32.6	55.2	51.7	31.4	22.7	22.7	7.6	5.2	4.7	4.0	2.9	2.3	2.3	1.2	1.2	1.0	1.0	

Notes: 1) General stores and sub-post offices occur both independently and in association. In order to arrive at the total number of general shops, Columns 2 and 3 must be summed. Thus there are 106 general shops in first order centres. Similarly, Columns 3 and 4 must be summed to get the total number of sub-post offices. This number is 96. Now the percentage of places having these facilities may be calculated and they are, respectively, 61.6 and 55.8.

2) The following are the functions assigned to Category 13, Miscellaneous.

Ashkirk -- artist specializing in greeting card designs.
Dryburgh -- tourist knitwear shop.
Gattonside -- architect; cabinet maker.
Howgate -- gift shop.
Polwarth -- antique dealer.
St. Abbs -- tourist knitwear shop.

FUNCTIONAL CHARACTERISTICS OF CENTRES ABOVE FIRST ORDER

CENTRES	Categories in Functional Classification																								Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
IIA CENTRES (N=35)																									
Aberlady	2	1			1					1				2		1	1	1	2		3	2	1		18
Addiewell and Loganlea	2		1										1	2		1	4		1		4	2			18
Bilston	5	1	1											1		1	1	1	1		1	1			14
Blackridge	7		3				1		1					2			5	2	2		2	2			27
Breich	2													1			2	1			1	2			9
Bridgend	5													1	2	1	1				1	2			13
Dalmeny	1											1				2					2	1			7
Danderhall	6	1	1				1							2		2	1	2	2		2	2			22
Dechmont	2	1											1	1		1		1			1	2			10
Dirleton	2	1										1		4	1	2		2		1	2	1			17
East Calder	8	2	1				1					1		2	2	5	3	4	2	1	3	4	1		40
East Whitburn	3													1		2	1								7
Elphinstone	2	1													1		1				1	2			8
Kirkliston	3		1		1		1							4	1		2	2	1	2	2	3	1		24
Kirknewton	4													1			3	3	1		1	2			15
Livingston Sta.	5	1	1											1	2		2		2		3	2			19
Longridge	4	1												1	1		1	1			2	1			12
Macmerry	4	1	1	1								1		1	1	2	3	2			1	2			20
Ormiston	6	1	1				2					2		2	4	1	6	3	4		2	2	1		37
Pencaitland	3													2		4	1	2	1		2	2			17
Philpstoun	2		1													1	3	1	1		1	1			11
Polbeth	3		1		1									3	2	1	1	1	3		2	1			19
Pumpherston	6		1				1							3	2		3		2		1	2			21
Ratho	5		3											2		3	2		1		2	2	1		21
Ratho Station	5	1	1											1		1		1							10
Rosewell	8	1	1	1			1					2		2	2		4	2	4		4	2			34
Seafield (W.L.)	4	1												1			1				1	1			9
Stoneyburn	7	3	1		1		1		2					3	2		6	2	2		5	2	1		38
Torphichen	3													1			2	1			2	2			11
Uphall	11	1	1	1			1		1			1		5	3	3	5	3	2	1	3	2	2		46
Uphall Station	3	1															1	1				1	1		8
Walkerburn	3		1											2			3	2	1	1	4	2	1		20
Wallyford	7		2				1				1	1		2	1		2	4	2	2		3	2		30
Whitecraigs	5	1					1							1	1	1	2	2			2	1			17
Winchburgh	9		1		1		1					1		2	2	2	1	3	4		5	2			34
Total	157	21	25	3	5	0	13	0	4	1	1	11	2	59	30	37	74	50	41	8	68	61	12	0	683
Mean	4.5	0.6	0.7	0.1	0.1	0	0.4	0	0.1	0.03	0.03	0.3	0.06	1.7	0.9	1.1	2.1	1.4	1.2	0.2	1.9	1.7	0.3	0	19.5
Percentage of places found in Category	100	54.3	62.8	8.6	14.3	0	34.3	0	8.6	2.9	2.9	25.7	5.7	88.6	48.6	57.3	88.6	74.4	60.0	17.1	88.6	94.4	28.6	0	

FUNCTIONAL CHARACTERISTICS OF CENTRES ABOVE FIRST ORDER (cont'd)

CENTRES	Categories in Functional Classification																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
IIB CENTRES (N=30)																									
Ancrum	4			1										1		1	2	1	1		2	2			15
Ayton	4	1			1	1		2				1		3		7	4	2	2	4	3	3	2		40
Balerno	8				1		1					1		2	2	4	3	1	4		3	2	2		34
Broughton	2													2		2	3	2	1		4	3	1		20
Chirnside	6	1	1											2		5	5	5	3	1	3	2	1		35
Cockburnspath	2		1											1		3	2	2	1		2	2	1		17
Coldingham	6	1			1			1						3		3	2	4	2		2	3	2		30
Denholm	4		1							1		1		2		4	3	3	1		3	2	1		26
Earlston	11	2	4		3		1							4	2	8	6	4	3		3	2	1		54
East Linton	10	2	2		1		1		1			2		4	1	7	4	4	3	1	2	3	1		49
Gifford	4	2		1						1				2		1	4	2	2		2	2	1		24
Gordon	3		1											1		1	2	3	1		3	2	1		18
Greenlaw	6		2				1					1		4		6	3	4	4		2	2	1		36
Gullane	11	2	1	1	1		1			1		2		8	2	6	3	3	11	2	3	2	1		61
Lauder	10	1	1		1		1							5		5	4	6	5	1	3	5	1		49
Lilliesleaf	5													2		2	3	1			2	2	1		18
Longniddry	4	1		1			1					1		1	1	3	2	2	6	1	2	2	1		29
Mid Calder	6	1	1		1									3	5	7	4	3	2	1	2	3	1		40
Morebattle	3		1											1		1	2	1	1		3	2	2		17
Newbridge	4													2		2	2	2			1	2			15
Newcastleton	12		4					1						2		3	4	3	4	4	3	2	1		43
Newtown St. Boswells	6	1	2		1		2							3		3	1	1	1	4	4	3	4		36
Pathhead	7	2	1			1							1	2	2	2	3	2	3		2	2	1		31
Reston	3	1		1					1	1				2		2	3	3	1	1	2	2	4		27
Roslin	7	1	1	1	1		1					1		2	3	3	5	1	5		3	2	1		38
St. Boswells	9		2		2		1				2	1		1	1	13	2	3	6	2	2	2	1		50
Stow	6	1	2									2		3		1	1	1	3	1	2	2	2		27
Swinton	4	1												1		2	2	2			2	2			16
West Linton	7	2					1			1		1		4	1	8	3	6	6		4	3	1		48
Yetholm	7	1												3		2	3	1	1		2	2	2		24
Total	181	24	28	6	14	2	12	4	2	5	2	14	1	76	20	117	90	78	83	23	76	70	39	0	967
Mean	6.0	0.8	0.9	0.2	0.5	0.1	0.4	0.1	0.1	0.2	0.1	0.5	0.03	2.5	0.6	3.9	3.0	2.6	2.8	0.8	2.5	2.3	1.3	0	32.2
Percentage of places found in Category	100	80.0	56.7	20.0	36.7	6.7	36.7	10.0	6.7	16.7	3.3	36.7	3.3	100	33.3	100	100	100	90.0	40.0	100	100	90.0	0	
IIIA CENTRES (N=7)																									
Blackburn	7	1	1				1		1					5	2	2	7	4	6		5	3			45
Cockenzie & Port Seton	15	3	2	3	1		2	1				2		5	2	5	6	6	2	3	4	3	1		66
Currie	12	3	1			2	1							2	3	3	3	4	14	1	4	4			57

FUNCTIONAL CHARACTERISTICS OF CENTRES ABOVE FIRST ORDER (cont'd)

CENTRES	Categories in Functional Classification																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24 Total
IIIA CENTRES (cont'd)																								
Easthouses	11	1	4	1	2		1		1					4	5	2	2	4	7		4	3		52
Fauldhouse	9	2	3	1	2		2				2	1		8	4	3	7	6	5		7	2	1	65
Newtongrange	17	5	5	1	4		2		1		1	1		5	3	1	5	2	8		3	4	1	69
South Q'ferry	12		2		2		2		1			1		10	3	5	6	2	5	4	6	4	1	66
Total	83	15	18	6	11	2	11	1	4	0	3	5	0	39	22	21	36	28	47	8	33	23	4	420
Mean	11.9	2.1	2.6	0.9	1.6	0.3	1.6	0.1	0.6	0	0.4	0.7	0	5.6	3.1	3.0	5.1	4.0	6.7	1.1	4.7	3.3	0.6	0 60.0
Percentage of places found in Category	100	85.7	100	57.1	71.4	14.3	100	14.3	57.1	0	28.6	57.1	0	100	100	100	100	100	100	42.9	100	100	57.1	0
IIIB CENTRES (N=6)																								
Coldstream	14	6	6	1	2	2	3			1				8	3	7	10	2	6	4	5	4	4	88
Duns	20	3	6	1	1		3	1	1	1		2	1	7	3	11	14	8	13	14	6	7	8	1 132
Eyemouth	12	2	3	1	2		2					1		6	1	6	11	2	6	6	6	5	2	74
Innerleithen	16	1	2	1	3	1	1		1					4	3	10	9	5	6	3	5	5	4	80
Melrose	13	1	6	2	4	1	1		1			1		7	3	13	9	7	8	3	6	7	6	99
West Calder	15	4	2	3	3		2	1	1	2	2	2	1	9	6	7	9	10	6		7	6	2	1 101
Total	90	17	25	9	15	4	12	2	4	4	2	6	2	41	19	54	62	34	45	30	35	34	26	2 574
Mean	15.0	2.8	4.2	1.5	2.5	0.7	2.0	0.3	0.7	0.7	0.3	2.0	0.3	6.8	3.0	9.0	10.3	5.7	7.5	5.0	5.8	5.7	4.3	0.3 95.7
Percentage of places found in Category	100	100	100	100	100	50.0	100	33.3	66.7	50.0	16.7	66.7	33.3	100	100	100	100	100	100	83.3	100	100	100	33.3
IVA CENTRES (N=9)																								
Armadale	25	2	5		2		2		2			2	1	11	10	6	12	10	9	4	6	5	1	115
Bonnyrigg & Lasswade	39	5	7	2	3	2	3		2		1	1	1	11	8	17	16	9	18	5	8	8	3	169
Broxburn	25	3	9	3	5	2	2		1	1		2	1	12	8	11	13	6	15		9	5	6	139
Gorebridge	22	8	5	2	3		2	1	2			2	1	7	4	8	6	3	11		7	5	2	101
Loanhead	22	4	5	1	3		1		1	1	1	3	2	5	5	11	13	7	7	6	5	5	1	1 110
Penicuik	35	6	9	2	5		4	1	2		1	2	1	9	11	12	14	7	10	6	9	7	4	157
Prestonpans	22	2	6	1	2	1	2		1			1	1	6	3	12	10	7	8	2	6	7	2	102
Tranent	31	9	9	3	4		3	1	3	1	1	2		9	8	15	17	15	9	5	6	5	3	159
Whitburn	13	3	3	4	1		2	1	1	1		5	2	7	6	6	11	11	6	3	5	5	3	99
Total	234	42	58	18	28	5	21	4	15	4	4	20	10	77	63	98	112	75	93	31	61	52	25	1 1151
Mean	26.0	4.7	6.4	2.0	3.1	0.6	2.3	0.4	1.7	0.4	0.4	2.2	1.1	8.6	7.0	10.8	12.3	8.3	10.3	3.4	6.9	5.9	2.9	0.1 127.9
Percentage of places found in Category	100	100	100	88.9	100	33.3	100	44.4	100	44.4	44.4	100	88.9	100	100	100	100	100	100	77.8	100	100	100	11.1

FUNCTIONAL CHARACTERISTICS OF CENTRES ABOVE FIRST ORDER (cont'd)

CENTRES	Categories in Functional Classification																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
IVB CENTRES (N=8)																									
Dunbar	24	12	20	6	4	1	2	1	3	6		2	2	24	8	17	9	10	14	4	8	10	5		192
Haddington	34	9	16	4	8	3	3	2	2	7	1		4	13	9	23	12	16	24	17	7	10	9	1	234
Jedburgh	24	5	9	3	5	1	2		2	3		2	1	11	6	15	14	5	11	7	6	8	5	1	146
Kelso	33	5	17	2	4	2	2	3	3	5		3		12	12	15	13	11	19	17	8	6	11	1	204
Linlithgow	23	5	7	1	4		3	1		2			1	17	9	18	14	10	11	12	7	9	3	1	158
North Berwick	27	12	16	4	4	4	3	1	2	12	1	2	1	25	10	14	10	8	19	6	7	7	7		202
Peebles	30	2	11	4	3	2	4		2	3	1	2		21	10	19	19	11	14	18	9	9	8	1	203
Selkirk	28	4	11	3	5	3	3	1	3	1		2		7	7	25	12	7	14	10	11	9	4	1	171
Total	223	54	107	27	37	16	22	9	17	39	3	13	9	130	71	146	103	78	126	91	63	68	52	6	1510
Mean	28.0	6.8	13.3	3.4	4.6	2.0	2.6	1.3	2.1	4.9	0.4	1.6	1.1	16.3	8.9	18.3	12.9	9.8	15.8	11.4	7.9	8.5	6.5	0.8	188.7
Percentage of places found in Category	100	100	100	100	100	87.5	100	75.0	87.5	100	37.5	75.0	62.5	100	100	100	100	100	100	100	100	100	100	75.0	
VA CENTRES (N=3)																									
Bathgate	43	6	20	3	9	1	5	1	5	5	3		4	24	16	19	21	18	31	15	17	8	28	3	305
Bo'ness	32	2	8	2	4		3	2	1		2		1	20	11	14	26	10	25	9	13	11	4	1	201
Musselburgh	80	9	20	5	5		6	3	7	4	1	5	2	32	21	34	40	20	43	11	16	10	12	1	387
Total	155	17	48	10	18	1	14	6	13	9	6	5	7	76	48	67	87	48	99	35	46	29	44	5	893
Mean	51.7	5.7	16.0	3.3	6.0	0.3	4.7	2.0	4.3	3.0	2.0	1.7	2.3	25.3	16.0	22.3	29.0	16.0	33.0	11.7	15.3	9.7	14.7	1.7	297.7
Percentage of places found in Category	100	100	100	100	100	33.3	100	100	100	66.7	100	33.3	100	100	100	100	100	100	100	100	100	100	100	100	
VB CENTRES (N=3)																									
Dalkeith	39	15	14	3	11		5	2	7	2	2	4	1	23	23	19	19	15	26	14	13	8	15	1	281
Galashiels	69	7	17	5	6	2	7	1	7	1	2	3	1	18	13	46	27	16	31	15	19	14	36	2	365
Hawick	78	9	25	4	7	7	7	1	9	4	3	3	2	39	19	51	39	25	37	30	18	13	17	4	451
Total	186	31	56	12	24	9	19	4	23	7	7	10	4	80	55	116	85	56	94	59	50	35	68	7	1097
Mean	62.0	10.3	18.6	4.0	8.0	3.0	6.3	1.3	7.7	2.3	2.3	3.3	1.3	2.7	18.3	38.7	28.7	18.7	31.3	19.7	16.7	11.7	22.7	2.3	365.7
Percentage of places found in Category	100	100	100	100	100	66.7	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	

APPENDIX F

Contact Area Profiles

CONTACT AREA PROFILES

(Figures represent running averages of central contacts for three adjacent zones)

Name of Centre	Concentric Distance Zones in Miles																										
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
IIA Centres																													
Aberlady	8.0	6.3	0.7	0.3				0.3	0.3	0.3		0.3	0.3	0.3															
Addiewell and Loganlea	1.3	0.7																											
Bilston	3.0	0.7																											
Blackridge	5.6	5.6	0.7	0.7	0.7	0.3																							
Breich	2.6	1.0	0.3																										
Bridgend	2.0	1.7	2.3	1.3	0.7																								
Dalmeny	5.3	3.7	0.3																										
Danderhall	7.3	3.0	1.3	0.7	0.3																								
Dechmont	2.6	0.7																											
Dirleton	5.3	2.7	1.0																										
East Calder	21.3	21.3	16.7	4.7	2.7																								
East Whitburn	1.0	0.3																											
Elphinstone	1.3	0.7	0.3	0.3																									
Kirkliston	6.1	4.0	1.1	0.3	0.3	0.3																							
Kirknewton	7.3	4.0	2.7	1.3	0.7																								
Livingston Station	0.3	0.3	0.3																										
Longridge	0.6																												
Macmerry	7.0	4.7	1.3	0.3	0.3																								
Ormiston	10.3	13.3	9.0	6.3	3.3	2.1	1.0																						
Pencaitland	9.3	6.7	4.0	1.3	0.7																								
Philpstoun	2.7	1.3	0.7	0.7	0.3		0.3	0.3	0.3																				
Polbeth	3.3	3.3	2.3	1.6	0.6																								
Pumpherston	8.0	6.0	4.0	2.0	1.0	0.7																							
Ratho	4.7	1.3	0.3																										
Ratho Station	3.7	4.7	5.3	4.0	2.7	0.7																							
Rosewell	9.0	7.0	3.0	1.3	0.3																								
Seafield (West Lothian)	1.0	0.3																											
Stoneyburn	2.0	1.0	0.3	0.3																									
Torphichen	2.0	0.6	0.6																										
Uphall	19.0	19.0	7.3	2.0	0.3	0.3	0.3	0.3	0.3																				
Uphall Station	1.7	0.7																											
Walkerburn	4.3	2.0	1.0	0.3	0.3	0.3	0.3	0.3	1.0	1.0	0.7																		
Wallyford	2.0	1.7	1.0	1.0	0.3																								
Whitecraigs	4.3																												
Winchburgh	9.3	8.3	2.0	0.3																									
IIB Centres																													
Ancrum	24.7	24.0	18.3	12.7	10.3	7.0	3.7	1.3	1.3	0.7	0.7	0.7	0.3			0.3	0.3	0.3	0.3	0.3									
Ayton	18.0	14.0	9.7	6.3	2.3	3.0	1.7	2.0	0.3	0.3		0.7	1.0	1.0	0.7														
Balerno	15.3	11.0	2.3	0.7																									
Broughton	8.7	9.7	6.7	5.3	2.7	1.3	1.0	0.7	1.0	0.7	0.7	0.7	0.7	0.3															
Chirnside	30.3	42.0	33.3	26.1	15.7	9.0	6.0	4.0	2.3	2.3	1.7	1.0																	
Cockburnspath	14.7	8.3	4.0	4.0	3.3	1.3	0.3																						
Coldingham	21.0	16.0	5.3	7.0	6.0	5.7	3.3	1.3	0.7																				
Denholm	21.3	26.3	21.3	16.7	11.7	7.7	4.7	2.3	0.7	0.3		0.3	0.3	0.7	0.3	0.3													
Earlston	31.7	34.3	34.3	22.3	13.3	6.3	3.7	3.7	2.3	3.7	2.3	2.3	0.3	0.3	0.3														
East Linton	31.0	33.0	23.3	15.3	8.0	3.7	1.7	1.0	0.7	0.3																			
Gifford	14.0	10.7	4.0	3.3	2.7	2.7	0.7	1.0	0.3	0.7	0.3	0.3																	
Gordon	25.0	29.7	26.3	17.0	12.7	9.0	6.0	4.7	6.0	5.3	4.3	2.0	2.3	1.7						0.3	0.3	0.3							

Name of Centre	Concentric Distance Zones in Miles																												
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Greenlaw	30.3	34.3	32.0	17.7	12.0	4.0		0.3	0.3	0.3										0.3	0.3	0.3							
Gullane	15.3	19.0	13.0	8.0	2.7	0.3		0.3	0.3	0.3	0.3	0.3																	
Lauder	30.0	37.0	30.7	19.3	14.7	12.7	12.7	7.0	2.3	1.0	0.7	0.7	0.7																
Lilliesleaf	18.7	20.7	10.0	8.3	3.3																								
Longniddry	13.3	12.0	6.0	5.0	3.3	3.0	0.3																						
Mid Calder	14.7	15.3	12.3	6.3	2.0	1.3	0.7	1.0	0.3	0.3																			
Morebattle	26.0	30.0	20.7	13.3	6.3																								
Newbridge	8.0	3.7	1.3	0.7	0.7	0.7																							
Newcastleton	12.7	15.3	16.7	16.3	13.7	9.0	4.7	3.0	3.3	4.0	3.7	2.3	0.3	0.3	0.7	0.7	0.3		0.3	1.0	1.7	1.3	1.0	0.7	1.0	0.7	0.3		
Newtown St. Boswells	23.7	27.7	20.7	12.3	5.7	1.3	0.3	0.3	0.3	0.3	0.3	0.3							0.3	0.3	0.3								
Pathhead	13.0	15.7	9.7	8.7	3.7	2.3	0.3	0.3									0.3	0.3	0.3										
Reston	9.7	10.3	5.3	4.7	3.7	1.7	1.3																						
Roslin	9.0	7.0	1.3	1.0	0.7																								
St. Boswells	39.0	47.7	36.0	18.7	11.0	5.7	4.0	1.0	1.0	1.0	0.7	0.7	0.3	0.3	1.3	1.0	1.0												
Stow	12.7	16.0	9.7	10.3	9.0	14.2	11.3	7.3	0.7	0.3	0.7	0.7	1.0	1.7	1.7	1.7	0.7	0.7	0.3										
Swinton	13.7	17.3	14.7	9.7	4.0	1.3	0.7	0.3																					
West Linton	27.3	29.3	20.7	12.3	6.0	2.3	0.3				0.3	0.3	0.3			0.3	0.3	0.3											
Yetholm	16.3	15.7	9.7	7.0	6.0	3.7	2.3	1.0	1.0	0.7																			
IIIA Centres																													
Blackburn	5.6	4.6	3.3	1.6	0.6																								
Cockenzie and Port Seton	2.7	2.7	2.3	2.0	1.3	0.3	0.3	0.3																					
Currie	16.3	16.3	10.3	4.0	0.7	0.3																							
Easthouses	4.7	3.7	1.0	0.3																									
Fauldhouse	5.0	3.6	0.3																										
Newtongrange	8.0	5.7	4.0	2.3	0.3																								
South Queensferry	19.0	21.0	14.3	4.0	2.3	0.7	0.7	0.3																					
IIIB Centres																													
Coldstream	18.3	34.0	37.8	34.7	24.0	14.0	14.0	11.0	7.0	4.7	3.7	3.7	3.0	4.3	3.7	2.3	1.7	2.3	1.3	0.7									
Duns	71.3	87.0	101.0	91.7	84.3	84.3	64.7	51.7	31.3	20.0	15.3	8.3	4.3	1.7	3.0	3.7	3.3	1.3	0.3	0.3									
Eyemouth	19.7	26.0	23.3	11.7	6.3	2.0	4.0	4.0	5.3	3.0	2.3	1.0																	
Innerleithen	28.3	31.0	24.7	17.0	10.7	7.7	10.3	11.7	10.0	7.3	6.0	4.7	3.3	2.7	0.7							0.3	0.3	0.3	0.3	0.3			
Melrose	54.3	50.0	30.3	19.0	14.0	11.3	6.7	7.0	6.7	5.5	5.0	4.7	2.7	2.3	1.0	1.3	1.0	0.7	1.0	2.0	2.3	2.7	0.7	0.3	0.3				
West Calder	54.0	55.6	39.6	19.0	16.6	8.0	5.3	2.0	1.0	0.6																			
IVA Centres																													
Armadale	25.6	24.3	8.6	1.3	0.3	0.3																							
Bonnyrigg and Lasswade	22.0	19.0	7.7	5.0	3.3	1.3	0.3	0.3	0.3																				
Broxburn	38.6	43.0	24.3	9.3	3.0	0.3			0.3	0.3	0.3																		
Gorebridge/Arniston	27.7	34.3	21.0	15.0	3.0	6.7	3.7	2.7	0.7	0.7	0.3	0.3																	
Loanhead	10.7	8.3	5.0	2.3	2.3	0.7	0.3	0.3	0.3	0.3																			
Penicuik	36.3	38.0	23.0	15.7	11.3	10.0	5.0	4.0	1.3	1.7	1.0	0.7	0.3																
Prestonpans	0.7	2.0	3.0	4.0	3.0	1.7	0.3																						
Tranent	28.7	32.7	29.3	30.7	28.0	23.7	16.0	9.7	5.7	3.3	2.0	0.3	1.7	1.7	1.7	0.3	0.3	0.7	0.7	0.7									
Whitburn	24.6	18.3	6.6	5.0	4.6	3.3	1.3																						
IVB Centres																													
Dunbar	20.0	28.7	50.3	53.3	53.3	34.7	26.0	21.7	16.3	11.3	6.7	6.3	3.0	1.7	0.7	0.3	0.3	0.3											
Haddington	78.0	118.3	131.0	104.3	73.7	42.3	22.3	10.7	7.3	4.3	3.0	1.0	0.3	0.3	0.7	0.7	0.3												
Jedburgh	61.7	105.7	112.3	97.0	60.3	53.0	33.7	21.0	5.0	4.3	3.3	1.7																	
Kelso	87.0	150.0	180.3	177.0	143.0	101.0	63.3	46.1	34.7	28.7	22.3	17.7	11.7	6.3	4.7	4.3	3.0	2.7	2.7	3.3	3.3	3.3	1.3	0.7			1.0	1.0	1.0
Linlithgow	46.0	58.0	40.6	17.3	1.3																								
North Berwick	76.0	103.7	80.3	54.3	29.0	21.7	10.3	6.3	4.3	1.3	1.3	1.7	2.0	1.7	0.3														

Name of Centre	Concentric Distance Zones in Miles																												
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Peebles	47.0	68.7	69.0	55.7	48.7	54.0	41.3	30.3	22.3	18.7	11.7	5.0	3.7	2.7	2.0	1.0	1.7	1.0	0.7										
Selkirk	58.7	81.0	58.3	45.0	27.3	27.7	20.0	20.0	13.0	12.3	15.7	15.1	19.3	16.3	17.0	12.7	14.3	7.7	5.0	1.7	0.7	0.3							
VA Centres																													
Bathgate	84.7	111.6	103.3	69.6	38.6	18.3	10.0	6.6	5.3	2.0	1.0	0.6																	
Bo'ness	23.0	31.3	23.0	15.0	9.0	6.3	3.3	1.3	1.3	1.3	0.7	0.7																	
Musselburgh	23.7	26.0	21.0	7.3	6.7	5.0	4.3	3.3	1.7	3.0	2.3	3.3	2.7	2.3	1.7	1.0	1.0												
VB Centres																													
Dalkeith	35.7	47.7	46.3	41.3	34.7	29.0	24.0	21.0	19.0	13.7	6.0	1.7	1.7	1.0	0.7	1.0	1.0	1.3	1.0	0.7	0.3	0.3	0.3	0.3					
Galashiels	71.0	97.7	93.0	82.0	69.0	56.0	44.3	43.3	42.3	34.7	30.3	23.0	17.0	11.7	8.7	8.0	6.7	5.3	4.0	3.0	1.3	0.3							
Hawick	63.7	74.3	89.7	105.0	116.7	114.0	79.7	61.0	46.3	41.0	35.3	27.0	21.7	17.0	11.0	9.0	4.7	4.3	2.7	1.3	0.3								
Mean Contact Area Profiles																													
IIA Centres	5.3	4.0	2.0	0.9	0.4	0.1	0.1		0.1																				
IIB Centres	19.6	21.1	15.3	10.5	6.6	4.0	2.4	1.5	0.8	0.8	0.6	0.5	0.3	0.2	0.2	0.1	0.1	0.1		0.1	0.1	0.1							
IIIA Centres	8.8	8.2	5.1	2.0	0.7	0.2	0.1	0.1																					
IIIB Centres	41.0	47.3	42.8	32.2	26.0	21.2	17.5	14.6	10.2	6.9	5.4	3.7	2.2	1.8	1.4	1.2	1.0	0.7	0.4	0.5	0.4	0.5	0.2	0.1	0.1	0.1			
IVA Centres	23.9	24.4	14.3	9.8	6.5	5.3	3.0	1.9	1.0	0.7	0.4	0.1	0.2	0.2	0.2			0.1	0.1	0.1									
IVB Centres	59.3	89.3	90.3	75.5	54.6	41.8	27.1	19.5	12.9	10.1	8.0	6.1	5.0	3.6	3.1	2.4	2.5	1.5	1.1	0.7	0.5	0.5	0.2	0.1					
VA Centres	43.9	56.3	49.1	30.6	18.1	9.9	5.9	3.7	2.8	2.1	1.3	1.5	0.9	0.8	0.6	0.3	0.3												
VB Centres	56.8	73.2	76.3	76.1	73.5	66.3	49.3	41.8	35.9	29.8	23.9	17.2	13.5	9.9	6.8	6.0	4.1	3.6	2.6	1.7	0.6	0.2	0.1	0.1					

MEAN HINTERLAND PROFILES OF FUNCTIONS

(Figures represent running averages of central contacts for three adjacent zones)

IIA Centres						
Food	0.9	0.9	0.6	0.4	0.2	0.1
S.W.R.I.	0.9	0.5	0.2	0.1		
Primary School	1.1	0.5	0.2	0.1		
Post Office	0.4	0.2				
Public House	0.3	0.2	0.1			
Bank	0.1	0.1				
Doctor	0.4	0.4	0.2	0.1	0.1	0.1
Chemist	0.4	0.3	0.2	0.1		
Hardware	0.1	0.1	0.1			
Petrol/Auto Service	0.4	0.3	0.1			
Dentist	---					
Laundry/Dry Cleaning	---					
TV Hire or Purchase	0.1	0.1				
Secondary School	0.1	0.1				
Automobile Purchase	0.1	0.1				
Clothing	---					

	Concentric Distance Zones in Miles																												
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
IIB Centres																													
Food	3.1	4.3	4.0	3.4	2.3	1.5	0.8	0.4	0.2	0.1	0.1																		
S.W.R.I.	1.5	1.0	0.4	0.3	0.2	0.1																							
Primary School	4.2	3.5	1.7	0.8	0.3	0.2	0.1																						
Post Office	1.1	1.0	0.5	0.2	0.1	0.1																							
Public House	1.4	1.5	1.0	0.6	0.4	0.3	0.1	0.1																					
Bank	1.0	1.2	0.8	0.5	0.3	0.2	0.1	0.1																					
Doctor	1.7	1.9	1.7	1.1	0.8	0.5	0.3	0.1																					
Chemist	1.1	1.2	1.0	0.5	0.3	0.1	0.1																						
Hardware	0.5	0.5	0.3	0.3	0.3	0.2	0.1																						
Petrol/Auto Service	2.3	2.7	1.7	1.1	0.6	0.5	0.3	0.2	0.1	0.1	0.1																		
Dentist	---																												
Laundry/Dry Cleaning	0.1	0.1	0.1																										
TV Hire or Purchase	0.1	0.1	0.1	0.1	0.1	0.1																							
Secondary School	0.5	0.8	0.9	0.7	0.4	0.2	0.1	0.1		0.1	0.1																		
Automobile Purchase	0.4	0.6	0.4	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1		0.1	0.1	0.1														
Clothing	0.4	0.5	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1																	
IIIA Centres																													
Food	1.4	1.5	1.1	0.4	0.2	0.1	0.1	0.1																					
S.W.R.I.	1.2	0.8	0.2	0.1																									
Primary School	1.3	1.0	0.4	0.1																									
Post Office	0.5	0.3	0.2																										
Public House	0.2	0.3																											
Bank	0.3	0.3	0.1																										
Doctor	0.8	0.8	0.5	0.2																									
Chemist	0.8	0.7	0.4	0.1	0.1																								
Hardware	0.3	0.2	0.1																										
Petrol/Auto Service	0.3	0.5	0.3	0.2	0.1																								
Dentist	0.3	0.4	0.3	0.2	0.1																								
Laundry/Dry Cleaning	0.1	0.1																											
TV Hire or Purchase	0.2	0.2	0.1																										
Secondary School	0.9	1.0	0.9	0.3	0.1																								
Automobile Purchase	---																												
Clothing	0.2	0.1	0.1																										
IIIB Centres																													
Food	5.3	6.6	6.0	5.1	5.3	4.9	3.9	2.7	1.9	1.3	0.9	0.7	0.4	0.4	0.2	0.2	0.2	0.1	0.2	0.3	0.3	0.2	0.1	0.1					
S.W.R.I.	0.4	0.3	0.2	0.1																									
Primary School	4.9	5.1	4.2	2.2	1.2	0.8	0.4	0.2	0.1	0.1																			
Post Office	2.7	2.8	1.9	0.7	0.4	0.3	0.3	0.2	0.1	0.1	0.1																		
Public House	1.4	1.6	1.3	0.6	0.4	0.2	0.2	0.1																					
Bank	2.4	2.8	2.4	2.0	1.5	1.2	0.7	0.4	0.2	0.1	0.1																		
Doctor	3.3	4.3	3.7	3.0	2.3	1.7	1.3	1.1	0.7	0.5	0.3	0.1																	
Chemist	4.3	4.9	4.3	2.8	2.2	1.5	1.2	0.8	0.5	0.3	0.2	0.1																	
Hardware	2.6	3.1	2.5	1.7	1.0	0.7	0.7	0.6	0.4	0.3	0.2	0.2	0.2	0.2	0.1														
Petrol/Auto Service	2.3	3.3	2.7	1.8	0.9	0.5	0.4	0.5	0.5	0.5	0.2	0.1	0.1	0.1															
Dentist	1.4	1.7	1.6	1.4	1.4	1.4	1.1	1.0	0.6	0.4	0.2	0.1																	
Laundry?Dry Cleaning	1.4	1.6	1.7	1.2	1.0	0.9	1.1	1.2	0.7	0.5	0.3	0.3	0.3	0.3	0.2	0.1	0.2	0.2	0.2	0.1									
TV Hire or Purchase	2.4	2.5	2.2	2.1	1.8	1.6	1.3	1.2	1.2	1.1	0.8	0.7	0.4	0.4	0.3	0.3	0.1	0.2	0.1	0.1									
Secondary School	2.8	4.4	5.3	5.3	4.7	3.8	3.0	2.8	2.4	2.1	1.8	1.4	0.7	0.3	0.5	0.6	0.6	0.2	0.1	0.1									
Automobile Purchase	1.0	1.1	1.0	0.6	0.7	0.5	0.5	0.3	0.3	0.1	0.1	0.1	0.1	0.1															
Clothing	2.3	2.6	2.4	1.9	1.8	1.8	1.5	1.3	0.7	0.5	0.3	0.2	0.1																

	Concentric Distance Zones in Miles																												
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
IVA Centres																													
Food	3.3	3.7	2.8	2.4	1.9	1.7	0.9	0.6	0.3	0.2	0.2	0.1	0.1	0.1	0.1														
S.W.R.I.	1.5	1.0	0.3	0.1	0.1																								
Primary School	1.9	1.4	0.4	0.2	0.1	0.1	0.1																						
Post Office	1.2	0.9	0.1	0.1																									
Public House	0.2	0.2	0.1	0.1	0.1	0.1																							
Bank	1.4	1.4	0.7	0.3	0.1	0.1	0.1																						
Doctor	1.8	1.7	1.0	0.6	0.4	0.2	0.1																						
Chemist	2.4	2.2	1.0	0.7	0.5	0.4	0.1	0.1																					
Hardware	1.6	1.8	1.2	0.9	0.8	0.8	0.6	0.4	0.2	0.1			0.1	0.1	0.1														
Petrol/Auto Service	1.6	1.5	0.6	0.4	0.2	0.1																							
Dentist	1.5	1.6	1.1	1.0	0.8	0.7	0.4	0.2	0.1																				
Laundry/Dry Cleaning	1.3	1.1	0.4			0.1	0.1																						
TV Hire or Purchase	0.9	1.1	0.6	0.4	0.2	0.1				0.1	0.1																		
Secondary School	2.3	3.2	3.0	1.8	0.9	0.3	0.2	0.1																					
Automobile Purchase	0.3	0.3	0.1	0.1	0.2	0.1			0.1	0.1																			
Clothing	0.8	1.0	0.7	0.5	0.4	0.4	0.3	0.1	0.1																				
IVB Centres																													
Food	5.9	9.1	9.2	8.4	6.8	5.1	3.3	2.1	1.4	1.2	1.0	0.7	0.7	0.5	0.5	0.4	0.3	0.2	0.1										
S.W.R.I.	0.1	0.1																											
Primary School	5.9	6.2	3.9	1.8	0.6	0.6	0.4	0.4																					
Post Office	2.6	3.6	3.1	2.2	1.3	0.8	0.2	0.1	0.1	0.1																			
Public House	2.2	3.2	3.0	2.3	1.5	1.1	0.6	0.4	0.1																				
Bank	4.0	6.5	6.5	5.6	3.7	2.7	1.6	1.2	0.9	0.8	0.6	0.3	0.2	0.2	0.2	0.1	0.1		0.1										
Doctor	4.9	7.5	7.4	5.2	3.2	2.2	1.7	1.0	0.4	0.3	0.2	0.2	0.2	0.3	0.3	0.2	0.1												
Chemist	4.9	7.8	8.0	7.7	5.8	4.6	2.3	1.4	0.8	0.5	0.4	0.2	0.3	0.2	0.2	0.1	0.1	0.1											
Hardware	4.0	6.4	6.5	6.0	4.7	3.7	2.5	1.9	1.2	0.9	0.6	0.4	0.3	0.1		0.1	0.2	0.1	0.1										
Petrol/Auto Service	5.9	8.0	8.0	6.6	4.8	2.4	1.2	0.7	0.5	0.5	0.4	0.3																	
Dentist	4.1	6.9	7.3	6.4	4.7	3.7	2.7	1.9	1.2	0.8	0.5	0.4	0.4	0.4	0.2	0.1	0.1	0.1	0.1										
Laundry/Dry Cleaning	3.8	6.0	6.0	5.3	4.0	3.7	2.7	2.6	2.0	1.8	1.6	1.5	1.2	0.8	0.5	0.3	0.3	0.3	0.3	0.2	0.1								
TV Hire or Purchase	3.3	5.1	5.6	4.8	3.9	3.1	2.3	1.7	1.0	0.9	0.7	0.5	0.2	0.1	0.2	0.2	0.2			0.1	0.2	0.2	0.1						
Secondary School	4.3	7.2	8.0	6.6	4.7	3.6	2.3	1.6	1.0	0.6	0.7	0.6	0.7	0.2	0.3	0.3	0.1												
Automobile Purchase	1.8	2.4	2.6	2.3	2.1	1.5	0.9	0.5	0.5	0.5	0.4	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1										
Clothing	3.6	5.4	6.0	5.7	4.7	3.5	2.6	2.2	1.9	1.3	0.9	0.7	0.7	0.5	0.4	0.3	0.3	0.1											
VA Centres																													
Food	4.3	6.0	5.4	3.0	1.6	0.9	0.7	0.6	0.3	0.3	0.2	0.1	0.1																
S.W.R.I.	---																												
Primary School	1.4	1.3	1.0																										
Post Office	2.7	3.0	1.7	0.9	0.3	0.1																							
Public House	1.0	0.9	0.3	0.2	0.2	0.2																							
Bank	2.6	3.1	2.4	1.3	0.6				0.1	0.1	0.1																		
Doctor	2.8	3.4	2.4	1.2	0.4	0.1																							
Chemist	3.6	4.4	3.6	2.0	0.8	0.1																							
Hardware	3.0	4.4	4.0	2.7	1.0	0.3	0.1	0.1																					
Petrol/Auto Service	3.8	4.3	3.8	2.8	2.3	1.6	0.8	0.4	0.4	0.2	0.2	0.5	0.2	0.2															
Dentist	4.0	5.3	4.8	3.3	2.2	1.5	0.8	0.2																					
Laundry/Dry Cleaning	2.2	3.3	2.6	1.7	0.4	0.1							0.2	0.2	0.2														
TV Hire or Purchase	3.1	4.3	3.8	2.4	1.2	0.8	0.4	0.4																					
Secondary School	4.7	6.2	7.1	4.8	4.1	2.5	1.7	1.1	1.2	1.0	0.4	0.3																	
Automobile Purchase	1.8	2.3	2.3	2.2	2.0	1.4	1.0	0.7	0.4	0.4	0.3	0.6	0.2	0.2	0.3	0.3	0.3												
Clothing	2.6	2.4	2.5	1.4	1.6	0.9	0.4	0.2	0.1			0.1	0.1	0.1															

VB Centres	Concentric Distance Zones in Miles																											
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Food	5.1	7.1	7.5	8.0	8.1	7.9	5.2	4.7	4.4	4.0	2.6	1.3	1.2	1.1	0.7	0.3	0.1	0.1	0.1										
S.W.R.I.	0.9	0.6																											
Primary School	5.4	5.4	3.9	2.9	2.2	1.0	0.6	0.3	0.4	0.4	0.3	0.2	0.1	0.1			0.1	0.1	0.2	0.1	0.1								
Post Office	2.1	3.1	2.9	2.1	2.1	1.7	1.0	0.4	0.4	0.3	0.2	0.1																	
Public House	1.5	1.9	1.8	1.2	1.3	1.0	1.0	0.7	0.7	0.4	0.2	0.1																	
Bank	3.6	5.0	5.4	5.1	4.8	4.3	2.8	2.1	1.4	1.2	1.0	0.6	0.3																
Doctor	3.6	4.6	4.6	3.8	3.6	3.2	2.0	1.4	0.7	0.6	0.4	0.4	0.3	0.2															
Chemist	3.9	7.0	7.5	7.2	5.9	5.4	4.1	3.1	2.2	1.9	1.1	0.8	0.6	0.6	0.3	0.1													
Hardware	3.7	5.7	6.6	7.5	7.3	6.3	4.9	3.7	3.1	2.0	1.5	0.9	0.5	0.2	0.1	0.3	0.2	0.3	0.3	0.1									
Petrol/Auto Service	4.5	5.9	6.1	4.7	4.3	3.7	2.2	1.7	1.2	1.0	0.8	0.3	0.3	0.2	0.2	0.4	0.3	0.2											
Dentist	3.9	5.7	5.9	7.1	7.0	7.5	5.1	5.2	4.7	4.6	3.4	2.2	1.8	1.2	0.6	0.2	0.2	0.2	0.2										
Laundry/Dry Cleaners	3.3	4.8	5.8	5.8	5.4	4.5	3.3	2.9	2.7	2.0	2.1	1.6	1.7	0.9	0.6	0.2	0.1	0.2	0.2	0.1									
TV Hire or Purchase	2.5	3.8	4.3	5.3	5.4	4.3	2.9	2.0	2.0	1.9	1.8	1.3	0.8	0.3	0.2	0.5	0.5	0.3	0.1	0.1									
Secondary School	4.3	6.8	7.5	7.1	6.0	5.0	4.1	4.2	3.1	2.9	2.0	1.9	1.3	0.9	0.7	0.5	0.3	0.3	0.2	0.1									
Automobile Purchase	1.8	2.2	2.4	2.3	2.5	2.3	1.9	1.8	2.0	1.3	1.1	0.6	0.8	1.0	0.8	0.7	0.1	0.1	0.1	0.1	0.1								
Clothing	3.2	5.3	6.0	7.8	7.7	8.2	7.1	8.0	7.1	6.0	4.5	4.3	3.6	3.1	2.7	2.7	2.1	1.7	1.2	0.9	0.3	0.1	0.1						

BIBLIOGRAPHY

BIBLIOGRAPHY

Articles

Barnes, J.A. "An Approach to More Effective Isopleth Mapping," Memorandum Folio, Southeastern Division, Assoc. of Amer. Geogrs., XV, 1963.

_____, "Isopleth Mapping at Large Scales," Memorandum Folio, Southeastern Division, Assoc. of Amer. Geogrs., XVIII, 1966.

Berry, B.J.L. "Ribbon Developments in the Urban Business Pattern," Annals, Amer. Assoc. Geogrs., XLIX, 1959, pp. 145-155.

_____, "The Impact of Expanding Metropolitan Communities upon the Central Place Hierarchy," L, 1960, pp. 112-116, Annals, Assoc. Amer. Geogrs.

Berry, B.J.L. and W.L. Garrison. "A Note on Central Place Theory and the Range of a Good," Econ. Geog., XXXIV, 1958, pp. 304-311.

_____, "Functional Bases of the Central Place Hierarchy," Economic Geography, XXXIV, 1958, pp. 145-154.

_____, "Recent Developments in Central Place Theory," Reg. Sci. Assoc., Papers and Proceedings, IV, 1958, pp. 107-120.

_____, "Alternate Explanations of Urban Rank-Size Relationships," Annals, Amer. Assoc. Geogrs., XLVIII, 1958, pp. 83-91.

Boesch, Hans, "Central Functions as a Basis for a Systematic Grouping of Localities," Abstracts of Papers, International Geographical Union, xviith International Geographical Congress, United States, 1952. Publication No. 6.

Bracey, H.E. "Towns as Rural Service Centres: An Index of Centrality with Special Reference to Somerset," Trans. of the Inst. of Br. Geogrs., XIX, 1953, pp. 95-105.

Brush, John E., "The Hierarchy of Central Places in Southwestern Wisconsin," Geog. Rev., XLIII, 1953, pp. 380-402.

Burke, T., "Semi-Logarithmic Graphs in Geography: A Pertinent Addendum," Prof. Geogr., XVI, 1964, pp. 19-21.

Burton, Ian. "A Restatement of the Dispersed City Hypothesis," Annals, Amer. Assoc. Geogrs., LIII, 1963, pp. 285-289.

Carter, Harold. "Urban Grades and Spheres of Influence in South West Wales: An Historical Consideration," Scot. Geog. Mag., LXXI, 1955, pp. 43-58.

_____, "The Urban Hierarchy and Historical Geography: A Consideration with Reference to North-east Wales," Geog. Studies, III, 1956, pp. 85-101.

_____ and M.E.L. Davies. "The Hierarchy of Urban Fields in Cardiganshire, Wales," Tijd. voor Econ. en Soc. Geog., LIV, 1963, pp. 181-186.

Carruthers, Ian. "A Classification of Service Centres in England and Wales," Geog. Journ., CXXIII, 1957, pp. 371-385.

Davies, W.K.D. "Centrality and the Central Place Hierarchy," Urban Studies, IV, 1967, pp. 61-79.

_____. "Some Considerations of Scale in Central Place Analysis," Tijd. voor Econ. en Soc. Geog., LVI, 1965, pp. 221-227.

Fleming, J.B. "An Analysis of Shops and Service Trades in Scottish Towns," Scot. Geog. Mag., LXX, 1954, pp. 97-106.

_____ and F.H.W. Green "Some Relations between Town and Country in Scotland," Scot. Geog. Mag., LXVIII, 1952, pp. 2-12.

Freeman, T.W. "The Irish Country Town," Irish Geog., III, 1954-58, pp. 5-14.

Fullerton, B. "The Localisation of Service Industries in England and Wales," Tijd. voor Econ. en Soc. Geog., LIV, 1963, pp. 126-135.

Godlund, S. "The Function and Growth of Bus Traffic within the Sphere of Urban Influence," Lund Stud. in Geog., Ser. B, No. 18, 1956, 80pp.

Green, F.H.W. "Bus Services as an Index to Changing Urban Hinterlands," Town Plan. Rev., XXII, 1951-52, pp. 345-356.

Green, Howard. "Hinterland Boundaries of New York City and Boston in Southern New England," Econ. Geog., XXXI, 1955, pp. 283-300.

Griffin, D.W. and L.W. Bowden. "Semi-log Graphs in Geography," Prof. Geogr., 1963, pp. 19-23.

Helle, Reijo, "Retailing in Rural Northern Finland, Particularly by Mobile Shops," Fennia, XCI, N:o 3, 1964, pp. 1-120.

Johnston, R.J. "Central Places and the Settlement Pattern," Annals, Amer. Assoc. Geogrs., LVI, 1966, pp. 541-549.

Jones, R. "Central Place Shopping and the Hierarchy and Location of Shopping Centres in a City: Edinburgh," in Aspects of Central Place Theory and the City in Developing Countries, Durham Conference of the Study Group in Urban Geography, Institute of British Geographers, September, 1967.

Macgregor, D.R. "Daily Travel: A Study in Time and Distance Around Edinburgh," Scot. Geog. Mag., LXIX, 1953, pp. 117-127.

Murdie, R.A. "Cultural Differences in Consumer Travel," Econ. Geog., XLI, 1965, pp. 211-233.

Philbrick, A. "Principles of Areal Functional Organization in Regional Human Geography," Econ. Geog., XXXIII, 1957, pp. 299-336.

Scott, P. "The Hierarchy of Central Places in Tasmania," Aust. Geogr., IX, 1964, pp. 134-147.

Shear, J.A. "A General Measure of Diversity," Prof. Geogr., XVII, 1965, pp. 14-17.

Shultz, G.M. "An Experiment in Selecting Value Scales for Statistical Distribution Maps," Surveying and Mapping, XXI, 1961, pp. 224-230.

Smailes, A.E. "The Urban Hierarchy of England and Wales," Geography, XXIX, 1944, pp. 41-51.

_____. "The Analysis and Delimitation of Urban Fields," Geography, XXXII, 1947, pp. 151-161.

Smith, R.H.T. "Method and Purpose in Functional Town Classification," Annals, Amer. Assoc. Geogrs., LV, 1965, pp. 539-548.

Stafford, H.A. "Functional Bases of Small Towns," Econ. Geog., XXXIX, 1963, pp. 165-175.

Thomas, E.H. "Toward an Expanded Central Place Model," Geog. Rev., 1961, pp. 400-411.

Ullman, Edward, "A Theory of Location for Cities," Amer. Journ. Socio., XLVI, 1941, pp. 853-864.

Watson, J.W. "Geography - A Discipline in Distance," Scot. Geog. Mag., LXXI, 1955, pp. 1-13.

Wheeler, P.T. "Travelling Vans and Mobile Shops in Sutherland," Scot. Geog. Mag., LXXXVI, 1960, pp. 147-155.

Unpublished Background Articles

Evenden, L.J. "Metropolitan Spheres of Influence and Geographical Regions," Seminar in Urban Geography, Department of Geography, University of Edinburgh, Spring, 1964.

_____. "The Development of Central Place Theory," Seminar in Urban Geography, University of Edinburgh, Autumn, 1964.

_____. "A Critical Review and Discussion of Thorpe's Classification of Rural Settlement as It Applies in South-east Scotland," Seminar in Urban Geography, University of Edinburgh, Autumn, 1965.

_____. "City and Region: A Critical Review of Hinterland Delimitation Methods and a Discussion of Some Applications in South-east Scotland," Seminar in Urban Geography, University of Edinburgh, Spring, 1966.

Books and Monographs

Arkin, H. and R.R. Colton. Statistical Methods. Fourth edition. Barnes and Noble, New York, 1956.

Barnum, H.G. Market Centers and Hinterlands in Baden-Württemberg. University of Chicago, Department of Geography Research Paper No. 103. Chicago, 1966.

Berry, B.J.L. Geography of Market Centers and Retail Distribution. Englewood Cliffs, N.J., Prentice-Hall, 1967.

_____ and H.M. Mayer, Comparative Studies of Central Place Systems. Geography Branch, U.S. Office of Naval Research, NONR 2121-18, NR 389-126, February, 1962.

_____ and A. Pred. Central Place Studies: A Bibliography of Theory and Applications. Regional Science Research Institute, Bibliographic Series, 1, 1965.

Bracey, H.E. Social Provision in Rural Wiltshire. London: Methuen Co., 1952.

Carter, H. The Towns of Wales: A Study in Urban Geography. Cardiff: University of Wales Press, 1965.

Christaller, W. Central Places in Southern Germany. Translated from the German by C.W. Baskin, Englewood Cliffs, N.J., Prentice-Hall Inc., 1966. Originally published in 1933.

Isard, W. Location and Space Economy. New York: Technology Press of M.I.T., and John Wiley and Sons Inc., 1956. Published in the United Kingdom by Chapman Hall Ltd, London.

Lösch, A. The Economics of Location. Translated from the German by W.H. Woglom and W.F. Stolper; second revised edition, 1943. Science Editions Paperback, 1967, John Wiley and Sons, New York, Authorized by the Yale University Press.

Mackie, J.D. A History of Scotland. Pelican Book A671, Penguin Books Ltd., Harmondsworth, Middlesex, 1964.

Madge, J. The Tools of Social Science. Longmans Green and Co. Ltd., London, 1953.

Marwick, W.H. Scotland in Modern Times. Frank Cass and Co. Ltd., London, 1964.

Moser, C.A. Survey Methods in Social Investigation. London: Wm. Heineman Ltd., 1958.

_____ and W. Scott. British Towns: A Statistical Study of Their Social and Economic Differences. Edinburgh and London: Oliver and Boyd, 1961.

Olsson, G. Distance and Human Interaction: A Review and Bibliography. Regional Science Research Institute. Bibliographical Series No. 2, 1965.

Pahl, R.E. Urbs in Rure. London School of Economics Geographical Paper No. 2, 1965.

Pitts, F.R. (ed.) Urban Systems and Economic Development. Papers and Proceedings of a Conference on Urban Systems Research in Underdeveloped and Advanced Economies, School of Business Administration, University of Oregon, Eugene, Oregon, 1962.

Directories and Gazetteers

The Annual Register of Pharmaceutical Chemists, 1965, London: Published under the direction of the Pharmaceutical Society of Great Britain.

The Baptist Handbook, 1965. London: Published under the direction of the Council of the Baptist Union of Great Britain and Ireland.

The Catholic Directory for the Year of Our Lord 1966, Burns and Oates, Publishers to the Holy See.

Church of Scotland Yearbook, 1966. Edited by the Rev. A. Herron. Department of Publicity and Publication, Edinburgh.

The Dentist's Register, 1965. London: The General Dental Council.

East Lothian Yearbook and Guide, 1964, 66th edition. Edited by K. Whitson. Haddington: The Haddingtonshire Courier.

Edinburgh and Leith Post-Office Directory, 1963-64 and 1964-65. Edinburgh: Edinburgh and Leith Post-Office Directory Ltd., 69 York Place.

Edinburgh Area Classified Telephone Directory, March, 1964, Trades and Professions. London: General Post Office.

Handbook of the United Free Church of Scotland, 1964-65. Glasgow.

Hospitals Yearbook, 1966. Edited by J.F. Milne. London: Institute of Hospital Administrators.

Johnston's Gazetteer of Scotland, Including a Glossary of the most Common Gaelic Names. Revised by B.B. Hartop, A.C.M. and M. Rodger. Edinburgh and London: W.&A.K. Johnston and G.W. Bacon Ltd. 2nd ed., 1958.

List of Registrars of Births, Deaths, and Marriages with Tables of Fees, Etc. Edinburgh: Registrar-General of Scotland, 1963.

The Medical Directory, 1965. London: J. & A. Churchill Ltd.

The Municipal Yearbook and Public Utilities Directory, 1966. Edited by W.A. Pullan. London: The Municipal Journal Ltd.

Newspaper Press Directory, 1965. London: Benn Bros. Ltd.

The Optician's Register, 1964. London: The General Optical Council.

Police and Constabulary Almanac for 1965, Official Register. London: R. Hazell Ltd.

Post Offices in the United Kingdom excluding the London Postal Area and the Irish Republic, 1964. Issued by H.M. Postmaster-General.

Register of Veterinary Surgeons and Supplementary Veterinary Register, 1965. Published by Authority of Parliament by the Royal College of Veterinary Surgeons.

Scottish Episcopal Church Yearbook and Directory for 1965-66. Published by the Representative Church Council.

Scottish Hospitals Directory, 1962. Scottish Home and Health Department, National Health Service, HMSO, Edinburgh.

Scottish Law Directory for 1965. The Law Society of Scotland. Edinburgh: Wm. Hodge and Company.

Scottish Licensed Trade Directory for the Year 1965-66. Glasgow: The "National Guardian" and Munro-Barn Publications Ltd.

Where To Stay In Scotland or National Register of Accommodation. Edinburgh: Scottish Tourist Board, 1965.

Yearbook of the Congregational Union of Scotland, 1965-66. Edited by John T. George. Glasgow: The Congregational Union of Scotland.

Public Documents

Board of Trade, Report on the Census of Distribution and Other Services, 1961. Part XIII, Area Tables, Scotland. London: HMSO, 1964.

_____, Statistics Division. Britain's Shops: A Statistical Summary of Shops and Service Establishments. London: HMSO, 1952.

County Development Plan, Survey Report, Berwickshire. County Buildings, Duns, 1959.

County of East Lothian, Survey Report. East Lothian County Council, Haddington, 1953.

County Development Plan, Survey Report, Midlothian. County Buildings, Edinburgh, 1956.

County Development Plan, Survey Report. Peeblesshire. County Buildings, Peebles, 1953.

County Development Plan, Survey Report. Roxburghshire. County Offices, Newtown St. Boswells, 1958.

County Development Plan, Survey Report. Selkirkshire. County Planning Department, Galashiels, 1952.

County of West Lothian, A Physical, Social and Economic Survey, West Lothian. Linlithgow, 1958.

Ministry of Transport. Rural Transport Surveys, Report of Preliminary Results. London: HMSO, 1963.

Scotland. Census of Population. Volume I. 1961.

_____. Census of Population. Volume I and III. 1951.

_____. Census of Population. Appropriate volumes, 1911 through 1931.

_____. General Registry Office. Index of Place Names, Scotland, Census, 1951. Edinburgh.

_____. General Registry Office. Place Names and Population, Scotland: an alphabetical list of populated places derived from the Census of Scotland. Edinburgh: HMSO, 1967.

Scottish Development Department. The Central Borders: A Plan for Expansion. Edinburgh: HMSO, 1968.

_____. Central Scotland: A Programme for Development and Growth. Cmnd. 2188. Edinburgh: HMSO, 1963.

_____. The Lothians Regional Survey and Plan. Two Volumes. Edinburgh: HMSO, 1966.

Scottish Office. The Scottish Economy, 1965 to 1970: A Plan for Expansion. Cmnd. 2864. Edinburgh, 1966.

Maps

Bartholomew Half-Inch Series, Great Britain. Sheets 41, Tweeddale; 45, Mid Scotland; 46, Firth of Forth.

Ordnance Survey of Great Britain. One Inch Map of Great Britain, Seventh Series. Sheets 61, 62, 63, 64, 68, 69, 70, 76.

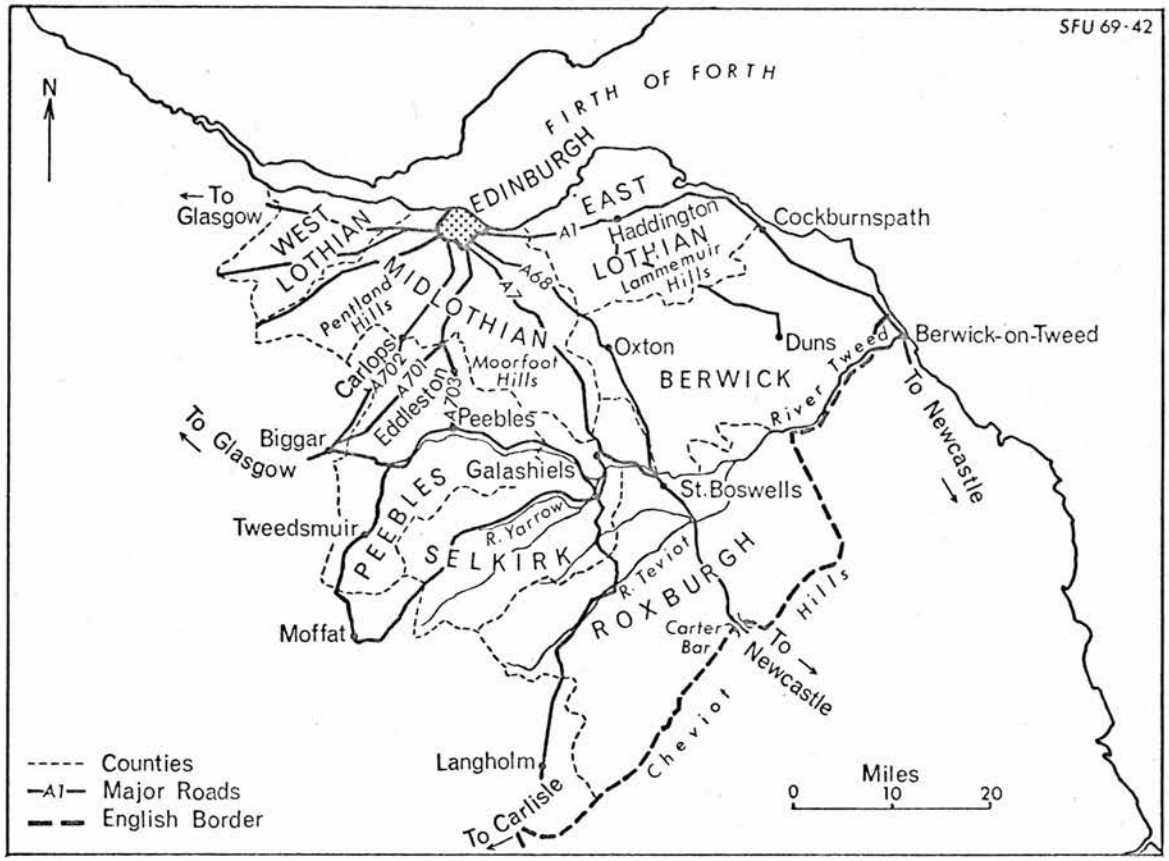
_____. Two and one-half Inch Series. Sheets covering south-east Scotland from the NT, NS, NU, and NY groups.

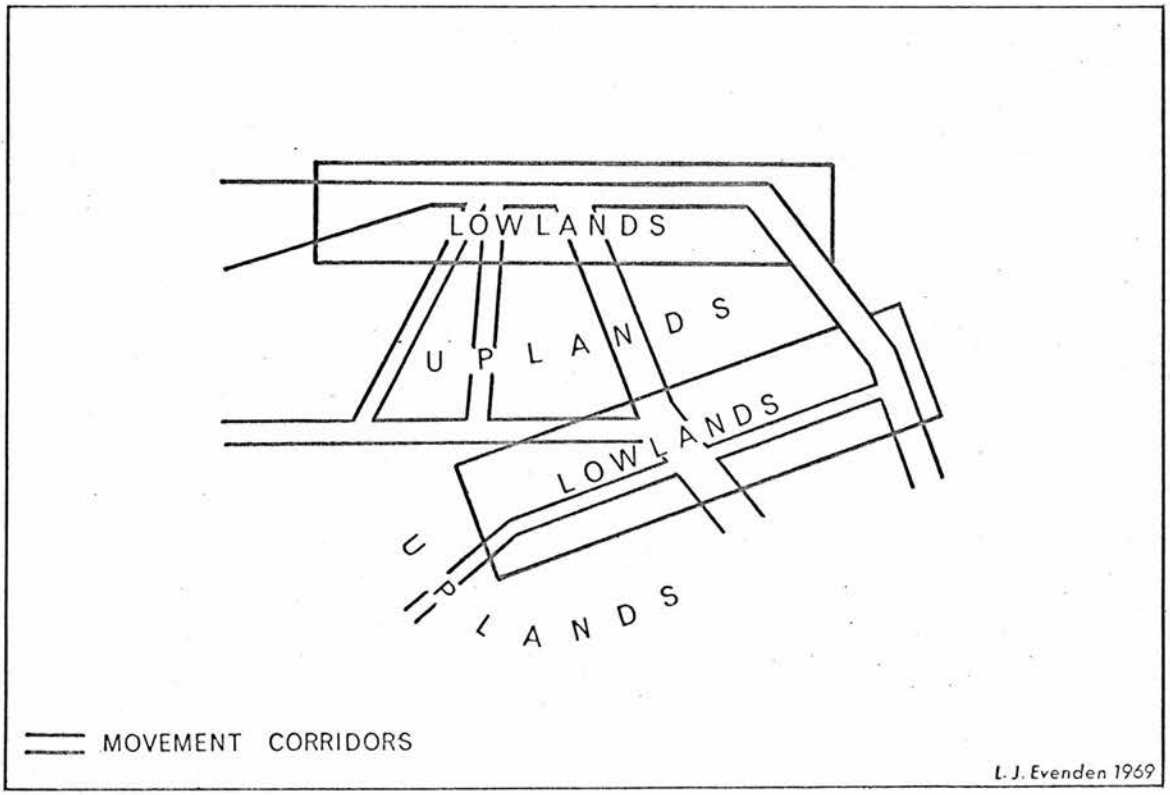
_____. Quarter Inch Map of Great Britain, Fifth Series. Sheet 7.

_____. Administrative Areas Edition. 4th edition. Sheets 1 and 3. 1:253,440.

_____. Local Accessibility Map. Planning Series, with Explanatory Text. 1:625,000. 1955.

MAP SECTION

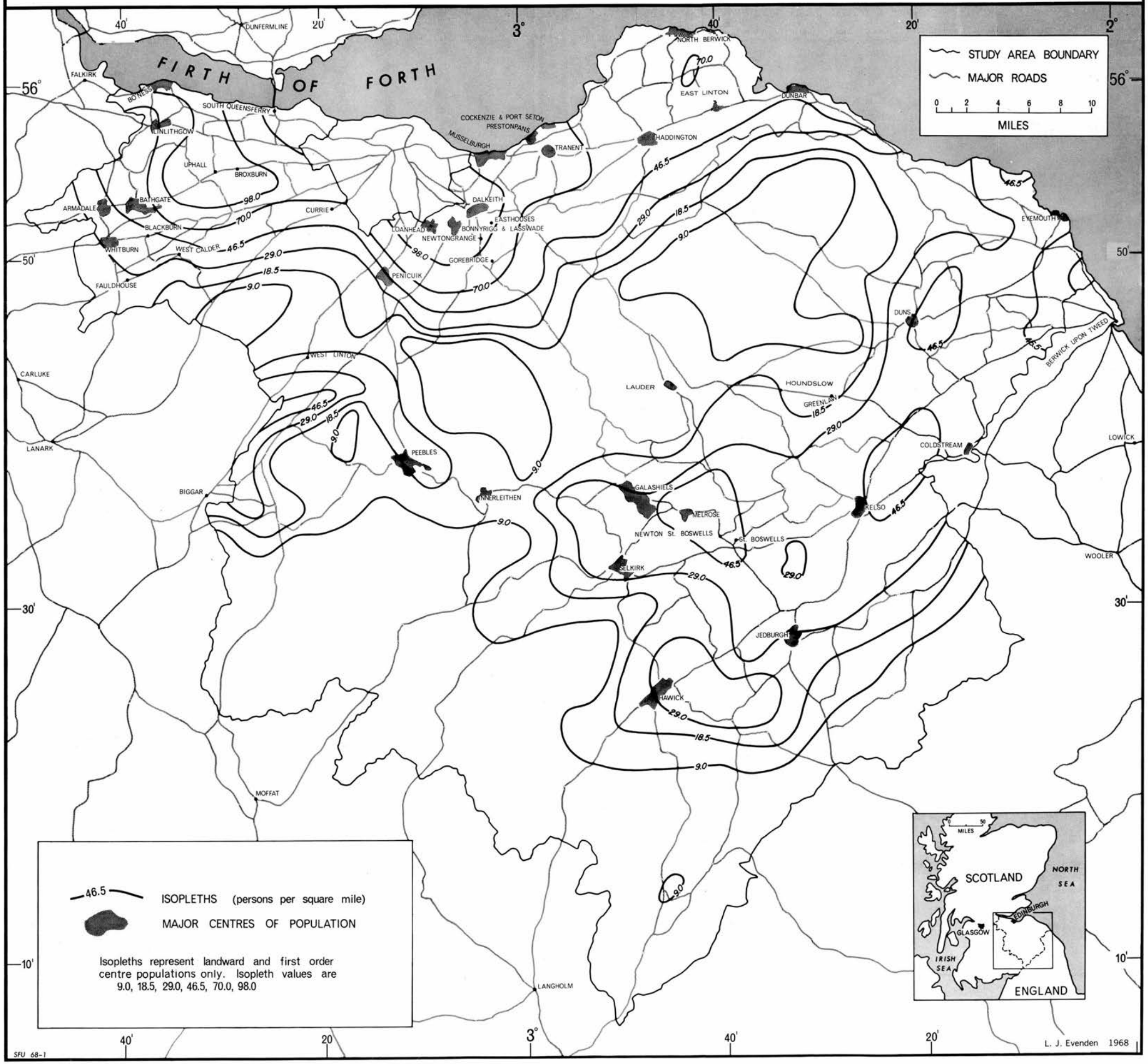




Map 1 - Some Principal Features and a Structural Framework of Settlement in South-east Scotland

MAP 2

POPULATION DISTRIBUTION AND DENSITY 1961



L. J. Evenden 1968

SFU 68-1

MAP 3

POPULATION DISTRIBUTION AND DENSITY 1951

FIRTH OF FORTH

STUDY AREA BOUNDARY
MAJOR ROADS
0 2 4 6 8 10
MILES

DUNFERMLINE, FALKIRK, BONNESS, SOUTH QUEENSFERRY, LINLITHGOW, UPHALL, BROXBURN, ARMADALE, BATHGATE, BLACKBURN, WHITBURN, WEST CALDER, CURRIE, FAULDHOUSE, COCKENZIE & PORT SETON, PRESTONPANS, MUSSELBURGH, TRANENT, DALKEITH, LOANHEAD, BONNYRIGG & LASSWADE, EASTHOUSES, NEWTONGRANGE, GOREBRIDGE, PENICUIK, NORTH BERWICK, EAST LINTON, DUNBAR, HADDINGTON, EYEMOUTH, DUNS, BERWICK UPON TWEED, WEST LINTON, CARLUKE, LANARK, BIGGAR, PEEBLES, LAUDER, GREENLAW, COLDSTREAM, LOWICK, INNERLEITHEN, GALASHIELS, MELROSE, NEWTON St. BOSWELLS, St. BOSWELLS, KELSO, SELKIRK, JEDBURGH, HAWICK, WOOLER, MOFFAT, LANGHOLM

60 42 28 19 11 96

28 ISOPLETHS (persons per square mile)
MAJOR CENTRES OF POPULATION

Isopleths represent landward and first order centre populations only. Isopleth values are 11, 19, 28, 42, 60, 96.

0 50 MILES
SCOTLAND
NORTH SEA
EDINBURGH
GLASGOW
IRISH SEA
ENGLAND

SFU 68-2

L. J. Evenden 1968

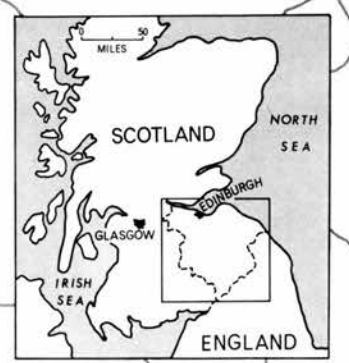
MAP 4

PERCENTAGE POPULATION CHANGE 1951–61

STUDY AREA BOUNDARY
MAJOR ROADS
0 2 4 6 8 10
MILES

ISOPLETH VALUES (percentage change)
+ 7.0
– 1.0
– 9.5
– 20.5
– 33.0

Percentage change in second order centres and above is shown beside place dot

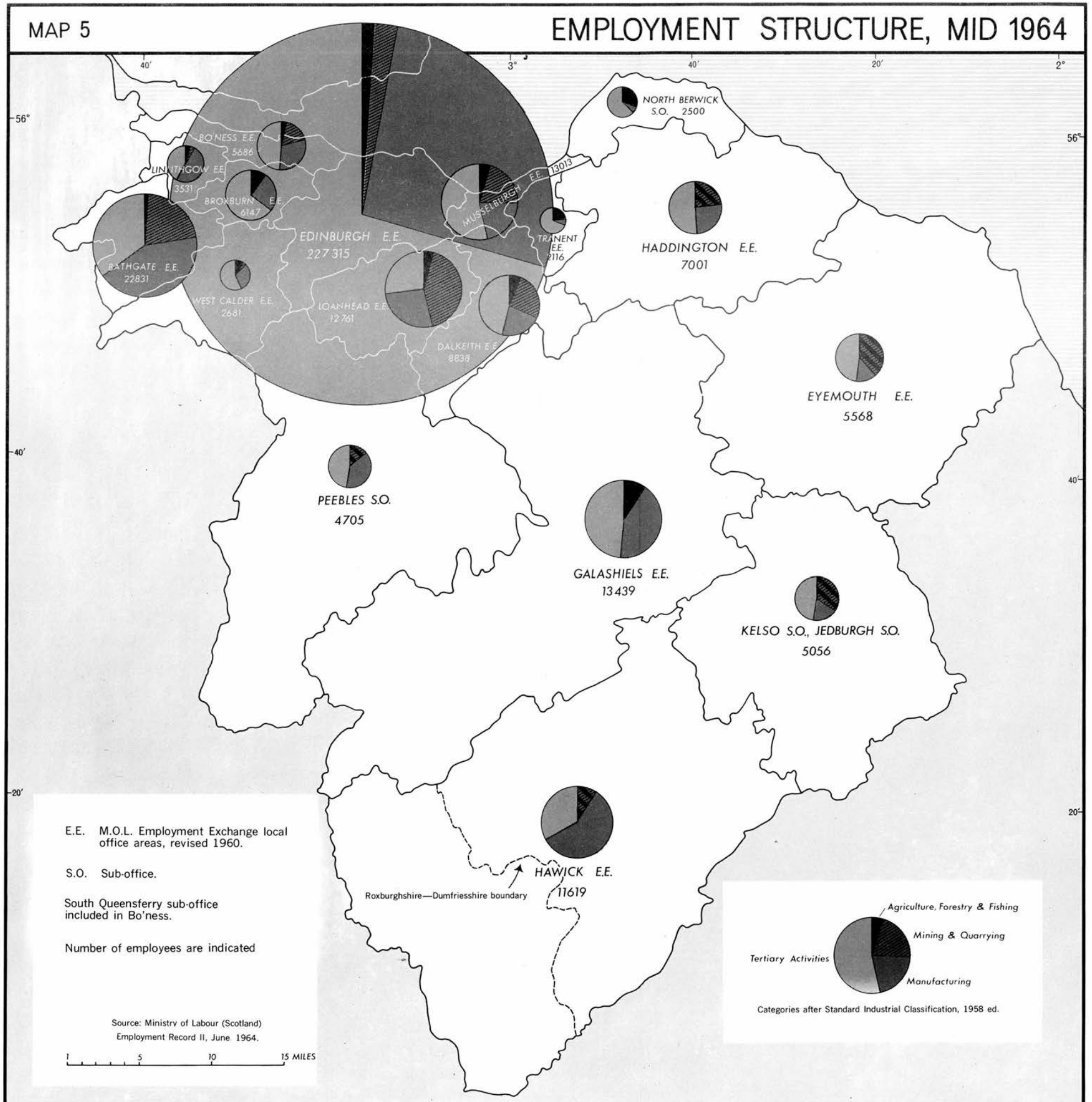


L. J. Evenden 1968

SFU 68-3

MAP 5

EMPLOYMENT STRUCTURE, MID 1964

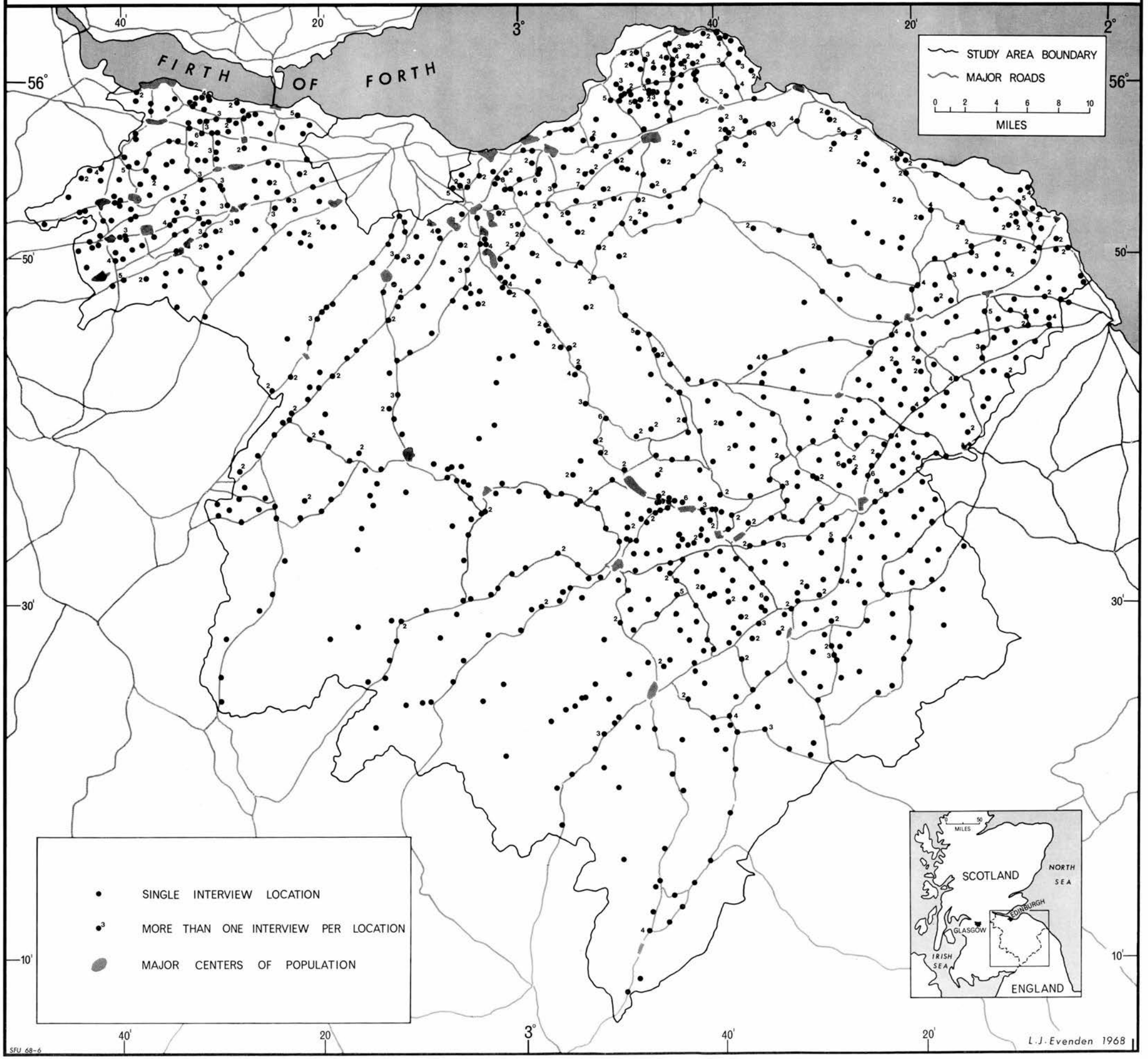


SFU 68-95

L. J. Evenden 1968

MAP 6

INTERVIEW LOCATIONS



SFU 68-6

MAP 7

FUNCTIONAL DIVERSITY OF CENTRES

FIRTH OF FORTH

BO'NESS
SOUTH QUEENSFERRY
LINLITHGOW
COCKENZIE & PORT SETON
PRESTONPANS
MUSSELBURGH
NORTH BERWICK
DUNBAR
TRANENT
HADDINGTON
BROXBURN
ARMADALE
BATHGATE
CURRIE
BONNYRIGG & LASSWADE
DALKEITH
EASTHOUSES
EYEMOUTH
BLACKBURN
LOANHEAD
NEWTONGRANGE
WHITBURN
WEST CALDER
GOREBRIDGE
PENICUIK
FAULDHOUSE
DUNS
Level A
Level B
PEEBLES
COLDSTREAM
GALASHIELS
INNERLEITHEN
MELROSE
KELSO
SELKIRK
JEDBURGH
HAWICK

STUDY AREA BOUNDARY
MAJOR ROADS
0 2 4 6 8 10
MILES

INDEX OF DIVERSITY (after Shear)

Range 18—120

○ < 56·5
⊙ 56·5—60·5
● > 60·5

----- Spatial differentiation of levels A and B centres

SFU 68-5

L.J. Evenden 1968

MAP 8

LOCATION AND HIERARCHICAL POSITION OF FUNCTIONAL CENTRES

STUDY AREA BOUNDARY
MAJOR ROADS
0 2 4 6 8 10
MILES

Broken line differentiates
Level A and Level B centres

LEVEL 'A' CENTRES
(high population per facilities ratio)
• FIRST ORDER CENTRE
◘ SECOND ORDER CENTRE
◙ THIRD ORDER CENTRE
■ FOURTH ORDER CENTRE
▣ FIFTH ORDER CENTRE

LEVEL 'B' CENTERS
(lower population per facilities ratio)
• FIRST ORDER CENTRE
○ SECOND ORDER CENTRE
◔ THIRD ORDER CENTRE
● FOURTH ORDER CENTRE
◉ FIFTH ORDER CENTRE

0 50 MILES
SCOTLAND
NORTH SEA
EDINBURGH
GLASGOW
IRISH SEA
ENGLAND

SFU 68-4

L. J. Evenden 1968

MAP 9

FOOD PURCHASES — TOTAL WEEKLY CONTACTS

FIRTH OF FORTH

STUDY AREA BOUNDARY
MAJOR ROADS
0 2 4 6 8 10
MILES

BO'NESS
LINLITHGOW
ARMADALE
BATHGATE
WHITBURN
COCKENZIE & PORT SETON
PRESTONPANS
MUSSELBURGH
TRANENT
HADDINGTON
NORTH BERWICK
EAST LINTON
DUNBAR
DALKEITH
LOANHEAD
BONNYRIGG & LASSWADE
PENICUIK
EYEMOUTH
DUNS
LAUDER
COLDSTREAM
PEEBLES
INNERLEITHEN
GALASHIELS
MELROSE
KELSO
SELKIRK
JEDBURGH
HAWICK

ISOPLETH VALUES
(Food purchase contacts per week.)

0
6.8
9.6
12·2
15.1

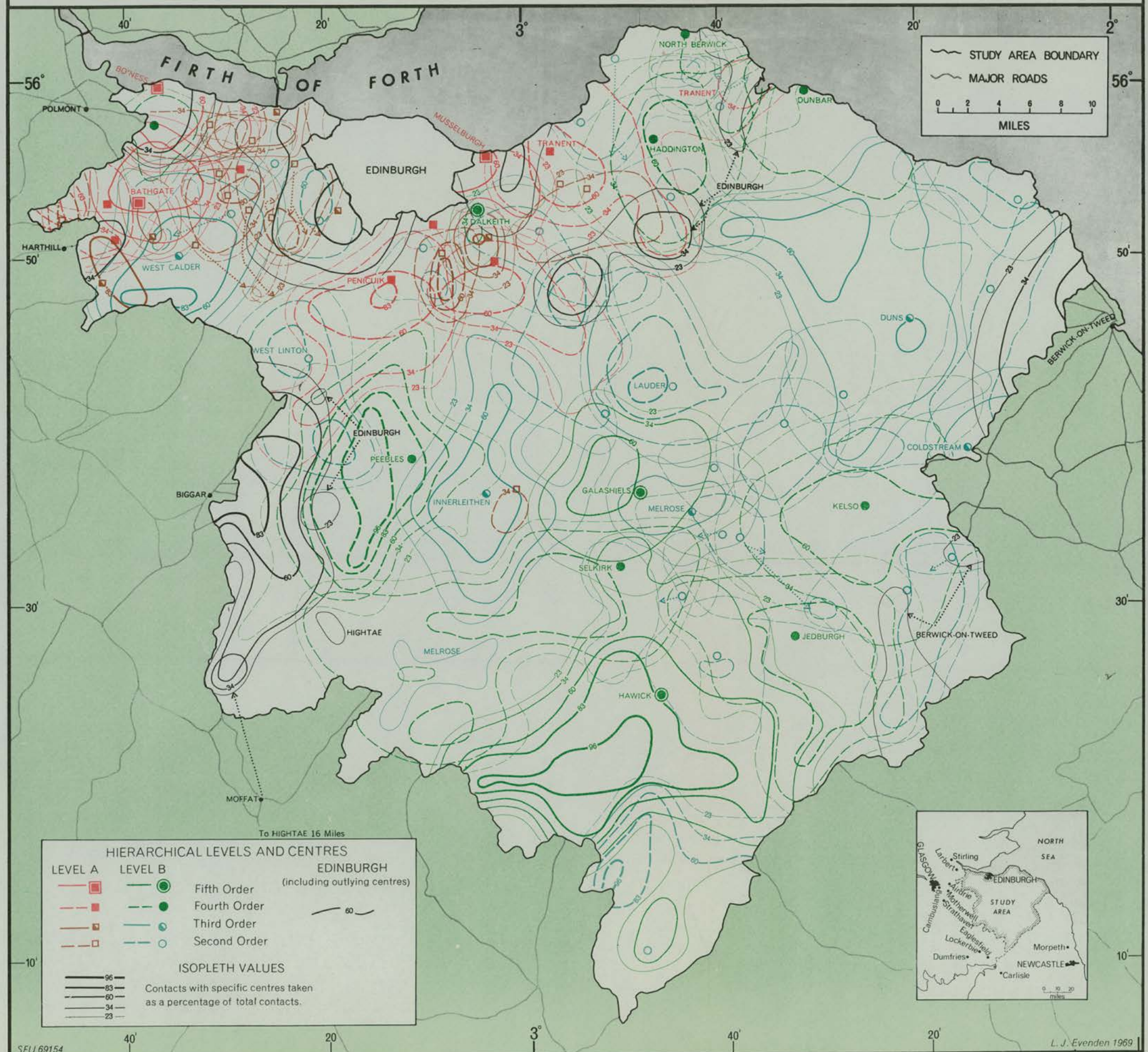
Contacts with first order centres are excluded

SFU 68-100

L.J. Evenden 1968

MAP 10

FOOD PURCHASES: SPECIFIC CONTACTS

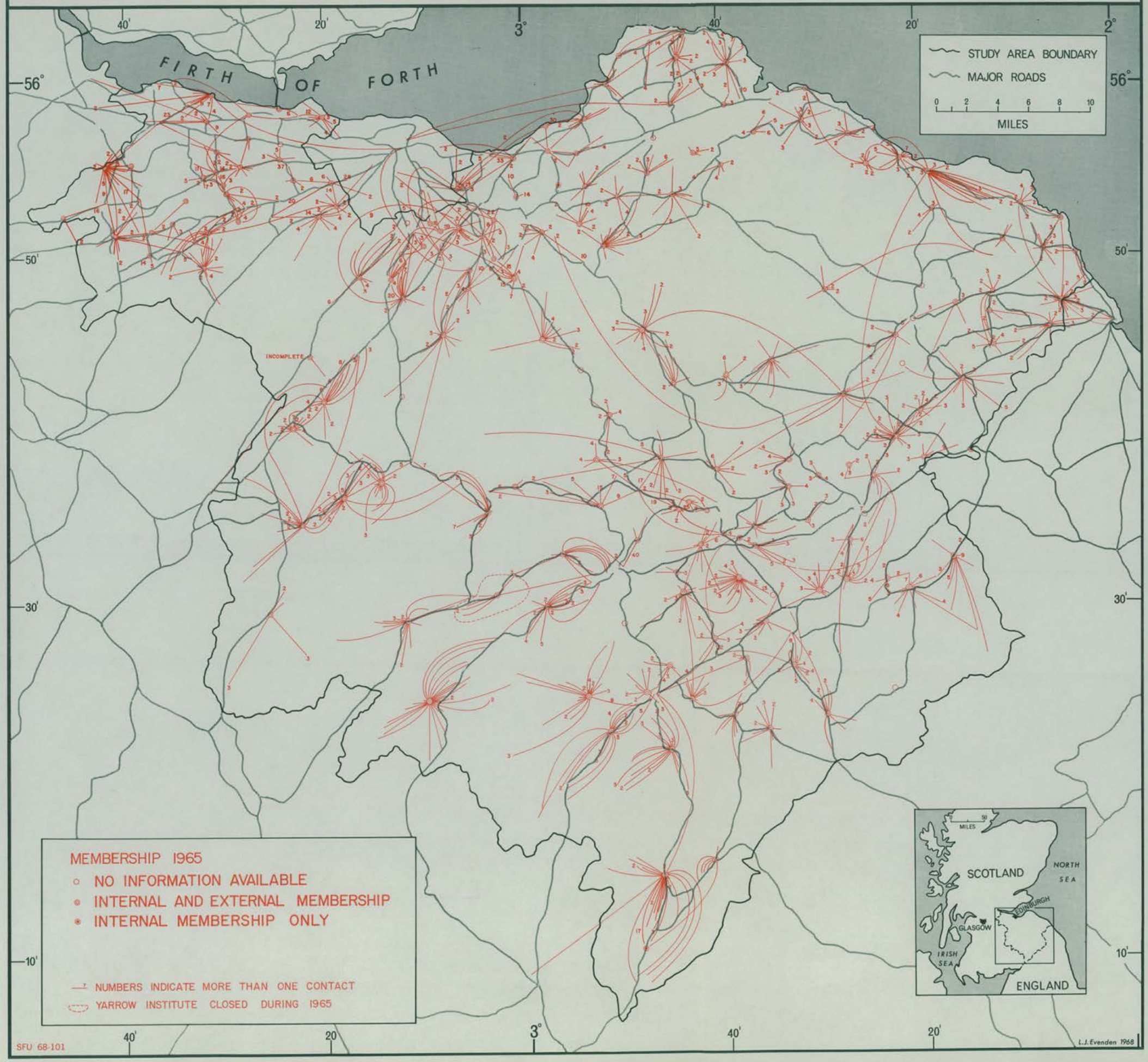


SFU 69154

L. J. Evenden 1969

MAP 11

SCOTTISH WOMEN'S RURAL INSTITUTE MEMBERSHIP AREAS

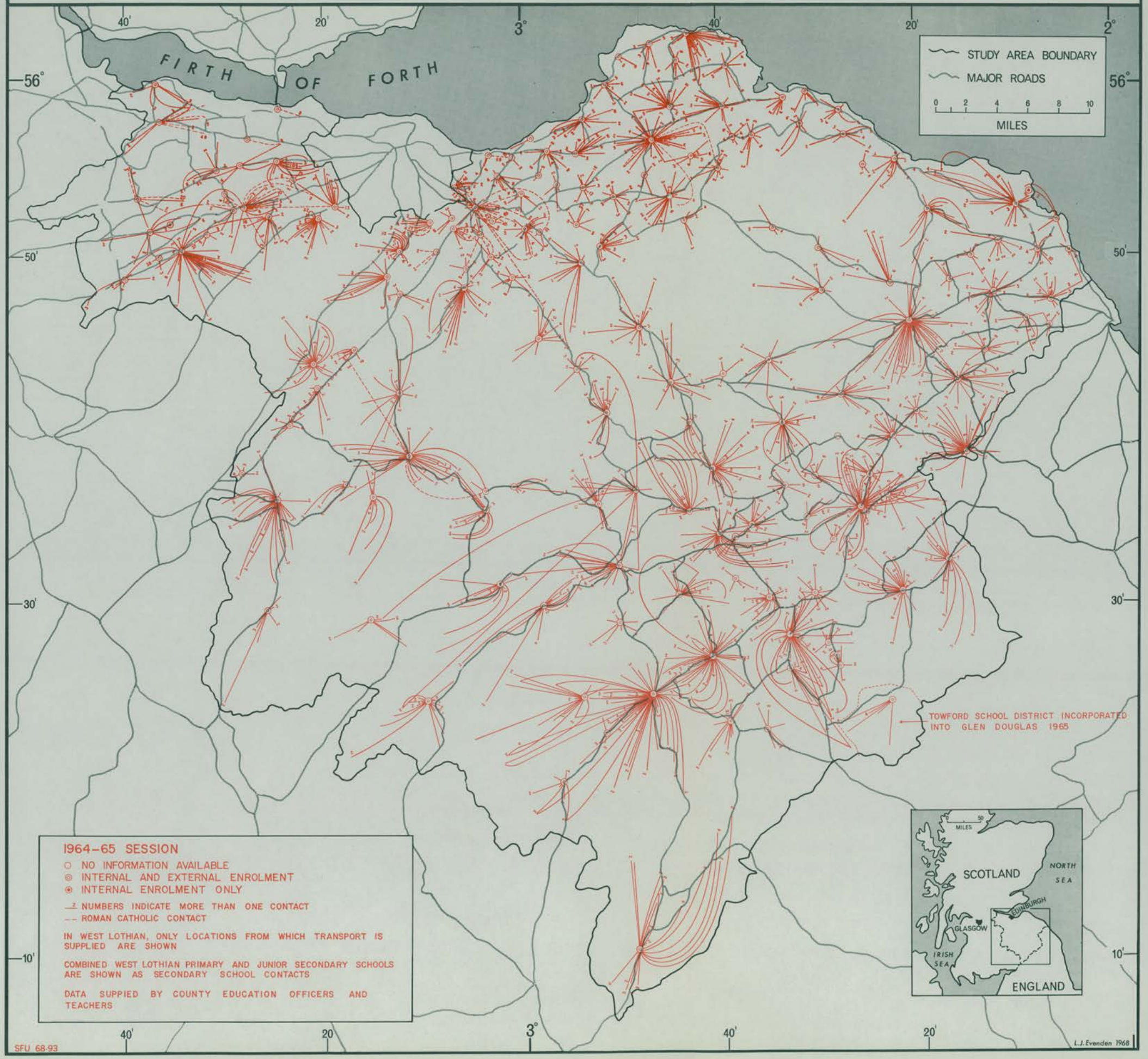


SFU 68-101

L.J. Evenden 1968

MAP 12

PRIMARY SCHOOL CATCHMENT AREAS

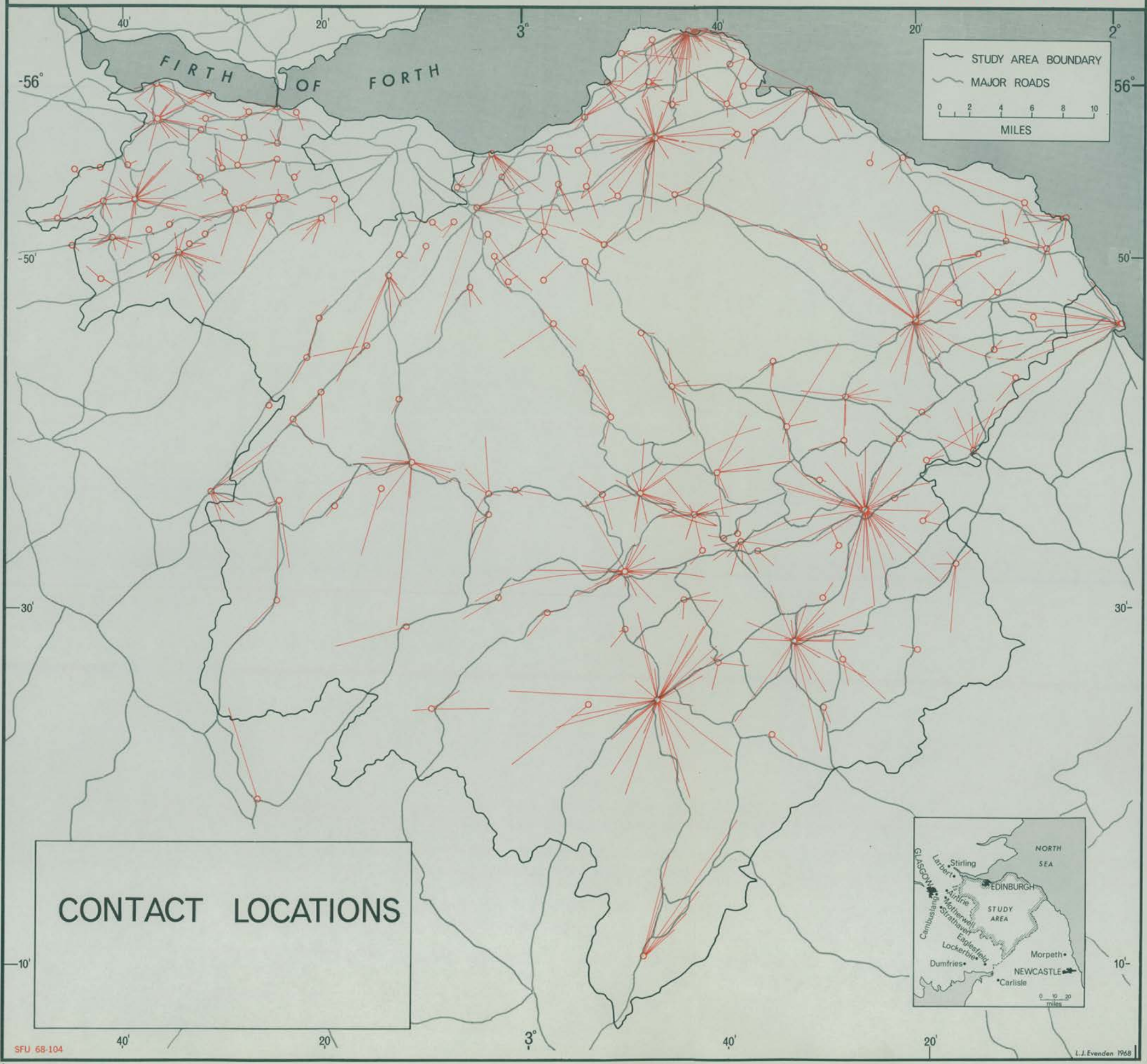


SFU 68-93

L.J.Evenden 1968

MAP 13

POST OFFICES

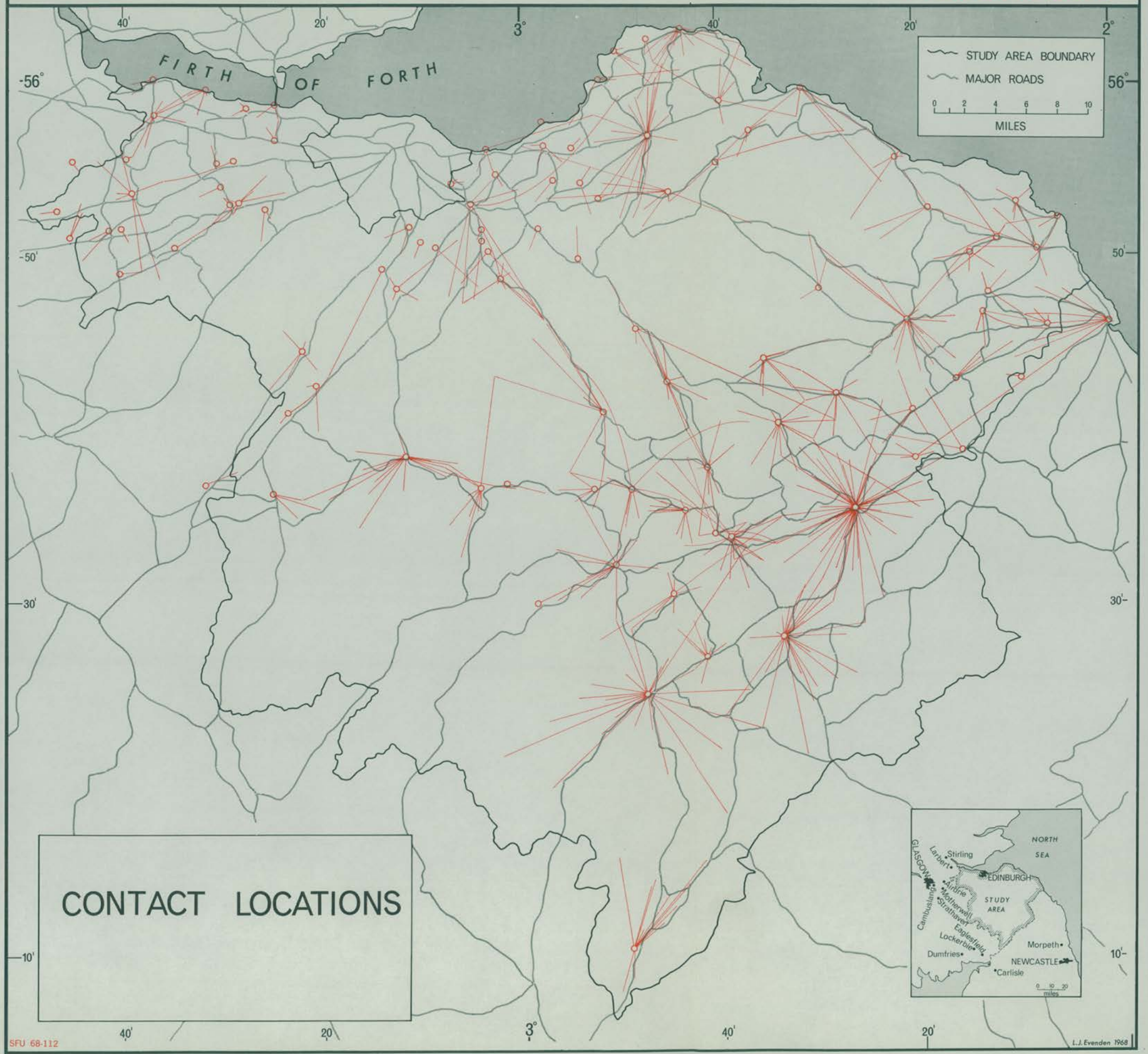


SFU 68-104

L.J. Evenden 1968

MAP 14

PUBLIC HOUSES



SFU 68-112

L.J. Evenden 1968

MAP 15

BANKS

FIRTH OF FORTH

40' 20' 3° 40' 20' 2°

56° 56°

50' 50'

30' 30'

10' 10'

STUDY AREA BOUNDARY

MAJOR ROADS

0 2 4 6 8 10

MILES

To Lockerbie 12 Miles

CONTACT LOCATIONS

SFU 68-108

L.J. Evenden 1968

MAP 16

DOCTORS

FIRTH OF FORTH

STUDY AREA BOUNDARY
MAJOR ROADS
0 2 4 6 8 10
MILES

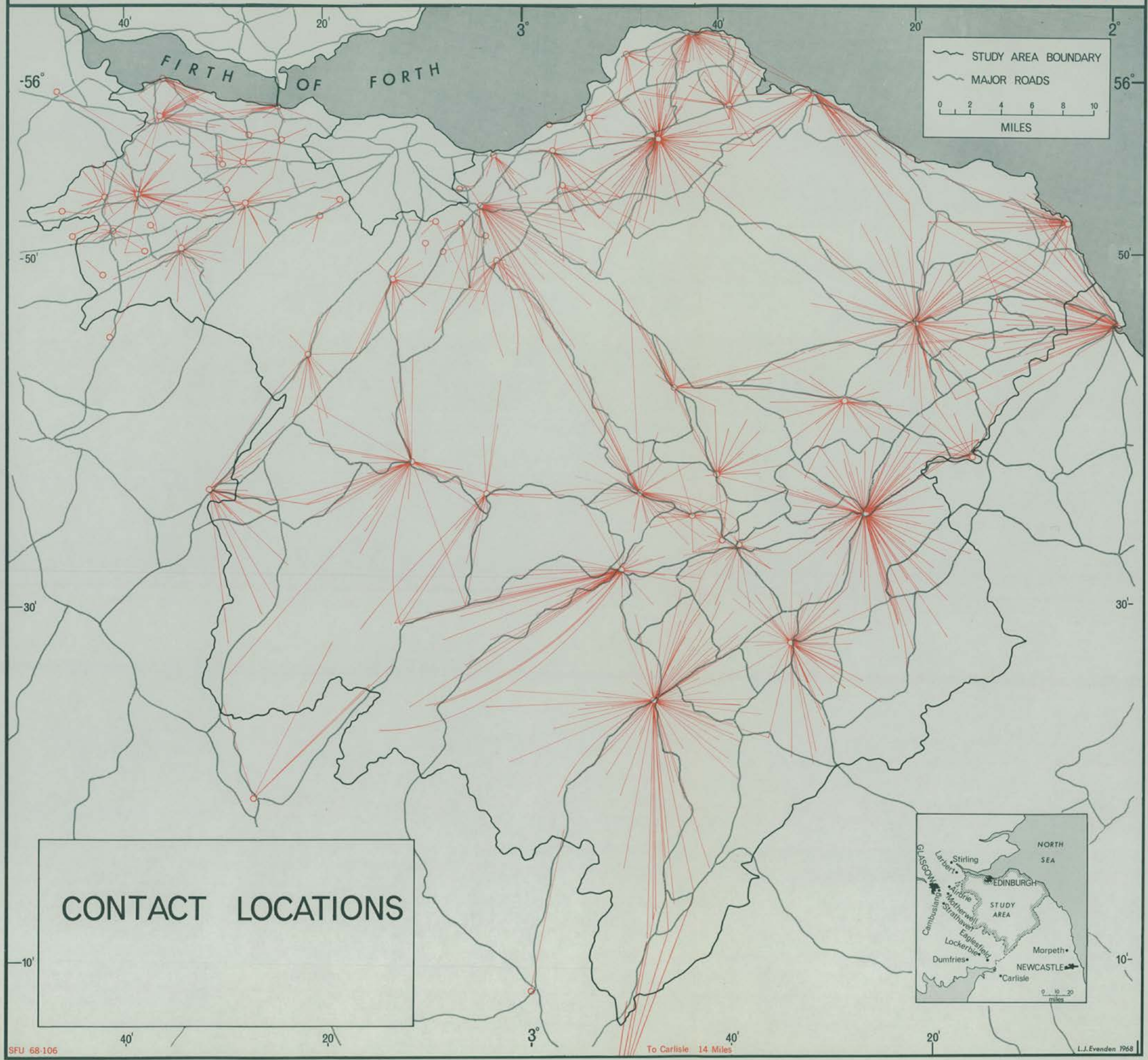
CONTACT LOCATIONS

SFU 68-102

L.J. Evenden 1968

MAP 17

CHEMISTS

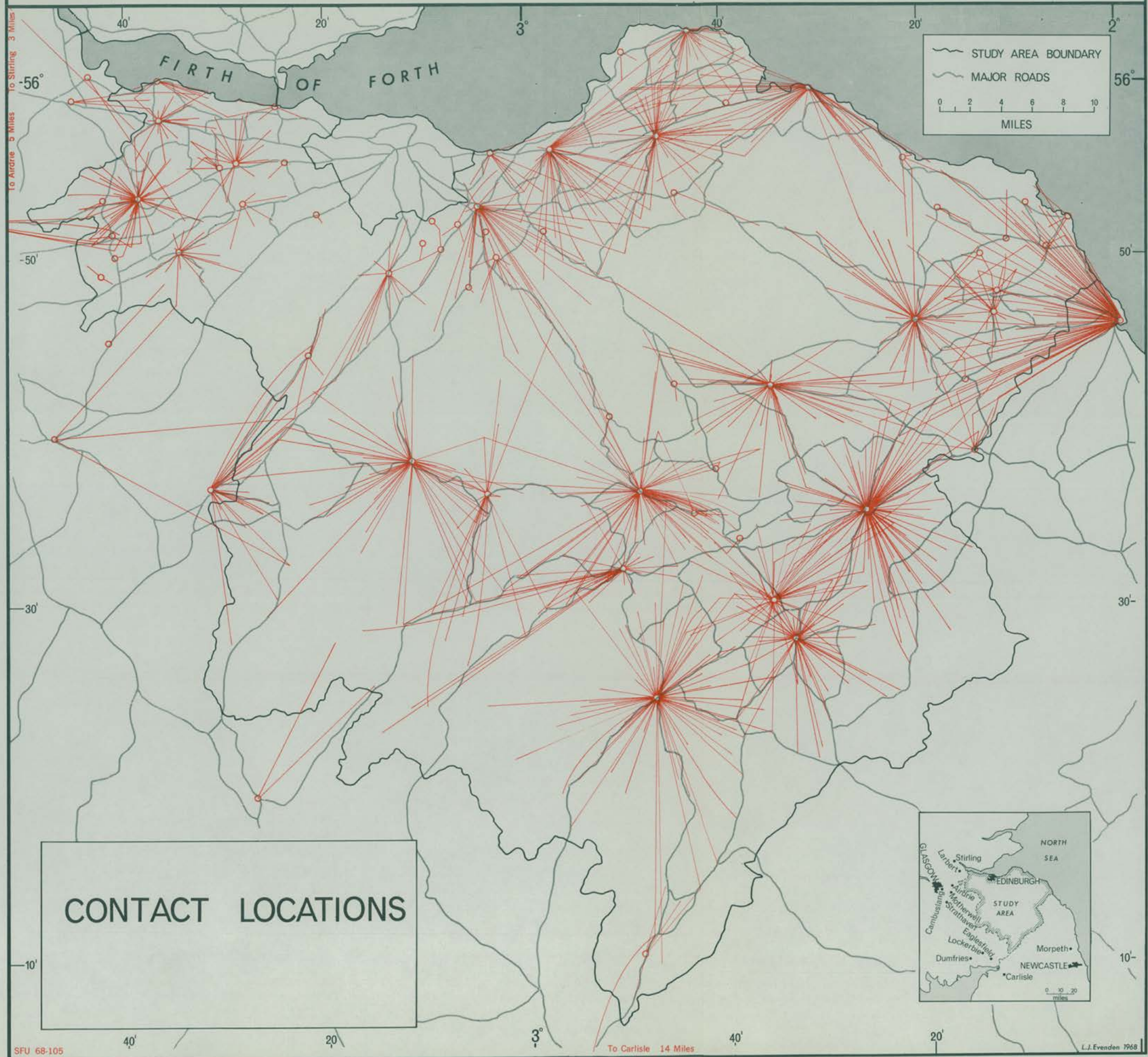


SFU 68-106

L.J. Evenden 1968

MAP 18

HARDWARE



CONTACT LOCATIONS

SFU 68-105

L.J. Evenden 1968

MAP 19

PETROL PURCHASES AND AUTOMOBILE SERVICING

FIRTH OF FORTH

STUDY AREA BOUNDARY
MAJOR ROADS
0 2 4 6 8 10
MILES

To Glasgow 16 Miles
To Motherwell 6 Miles
To Strathaven 10 Miles
To Newcastle 37 Miles
To Dumfries 2 Miles
To Carlisle 14 Miles

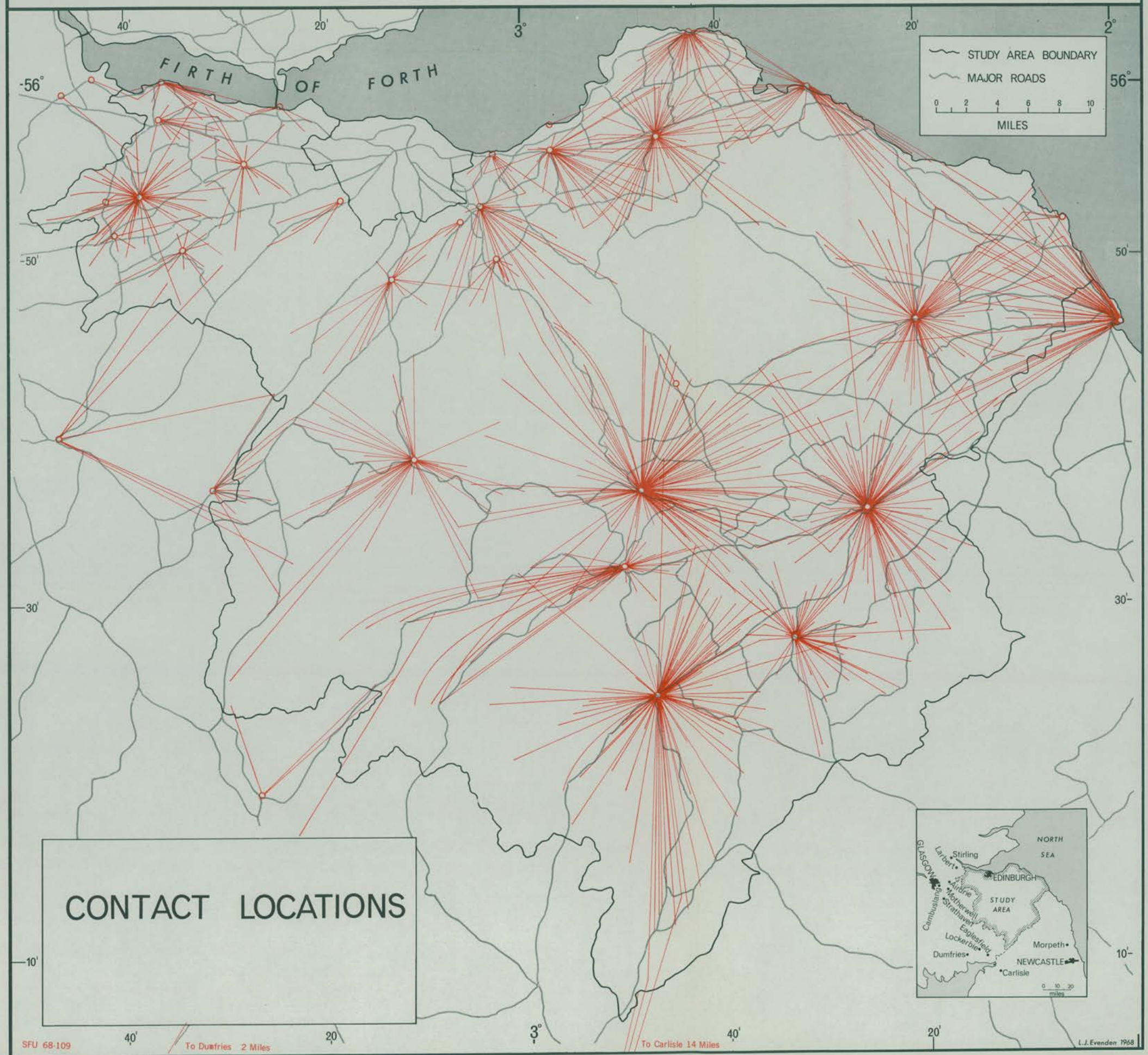
CONTACT LOCATIONS

SFU 68-113

L.J. Evenden 1968

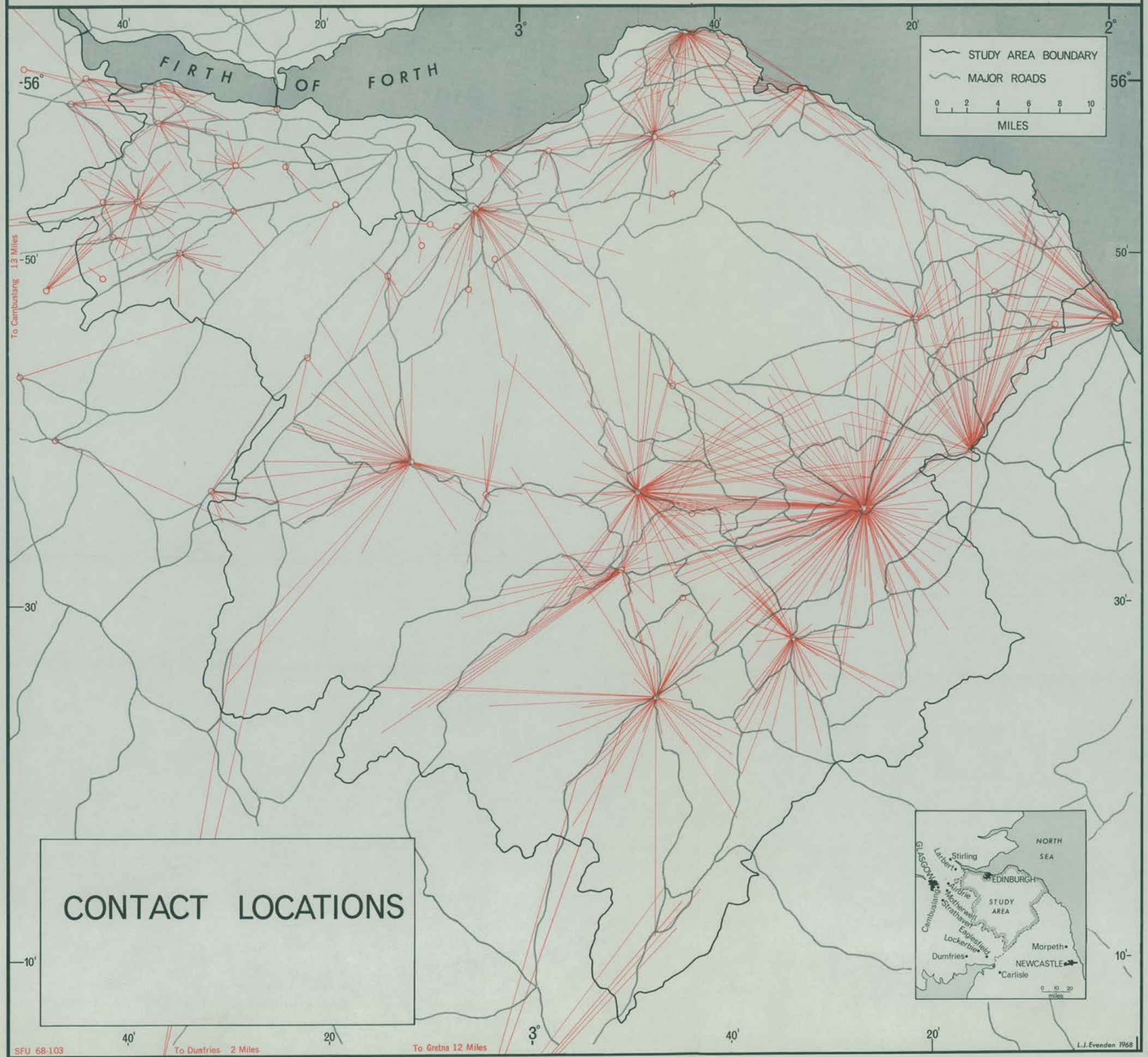
MAP 20

DENTISTS



MAP 21

LAUNDRIES AND DRY CLEANERS

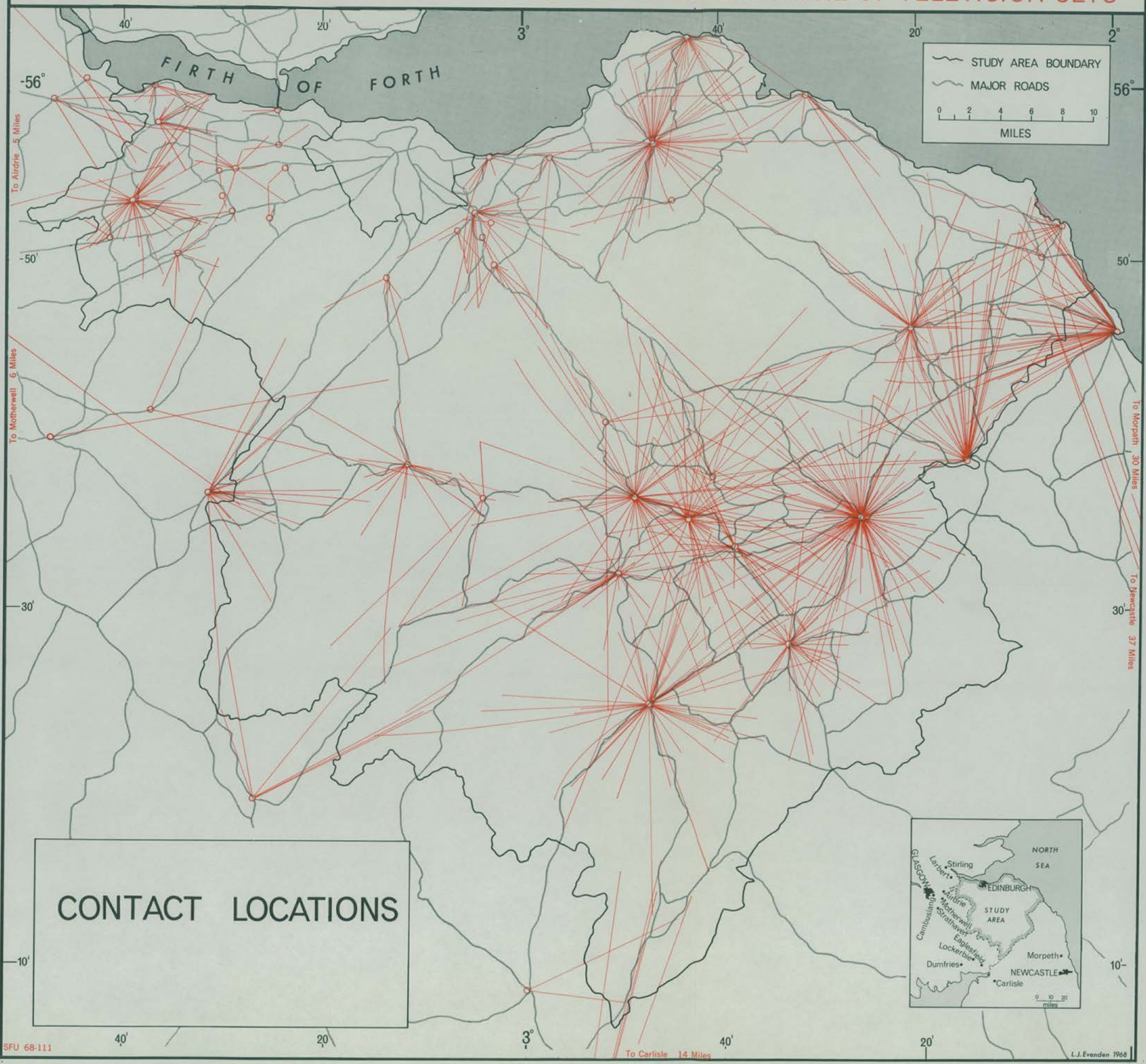


SFU 68-103

L.J. Evenden 1968

MAP 22

PURCHASE AND/OR HIRE OF TELEVISION SETS

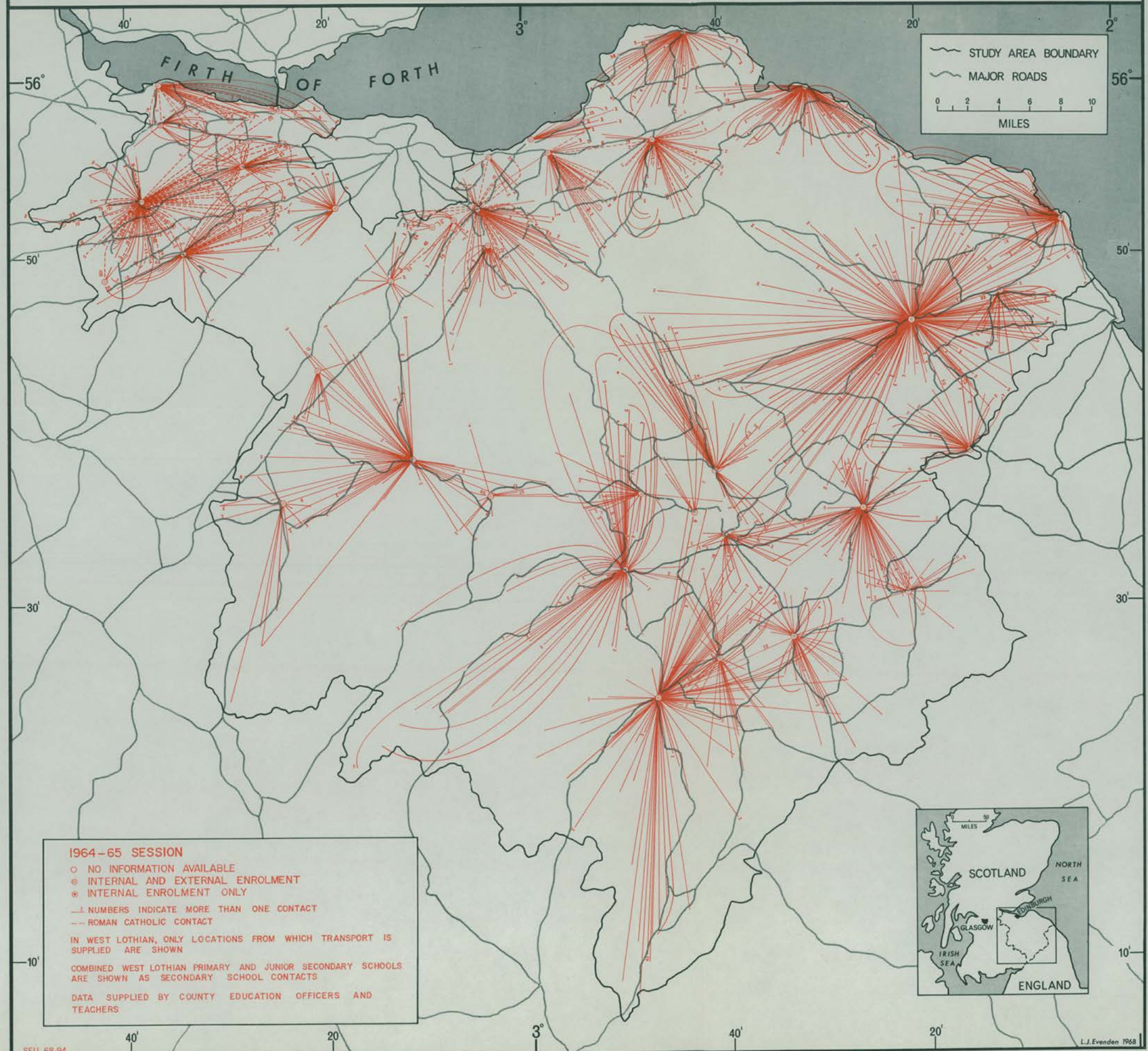


SFU 68-111

L.J. Evenden 1968

MAP 23

SECONDARY SCHOOL CATCHMENT AREAS



SFU 68-94

L.J. Evenden 1968

MAP 24

AUTOMOBILE PURCHASES

FIRTH OF FORTH

STUDY AREA BOUNDARY
MAJOR ROADS
0 2 4 6 8 10
MILES

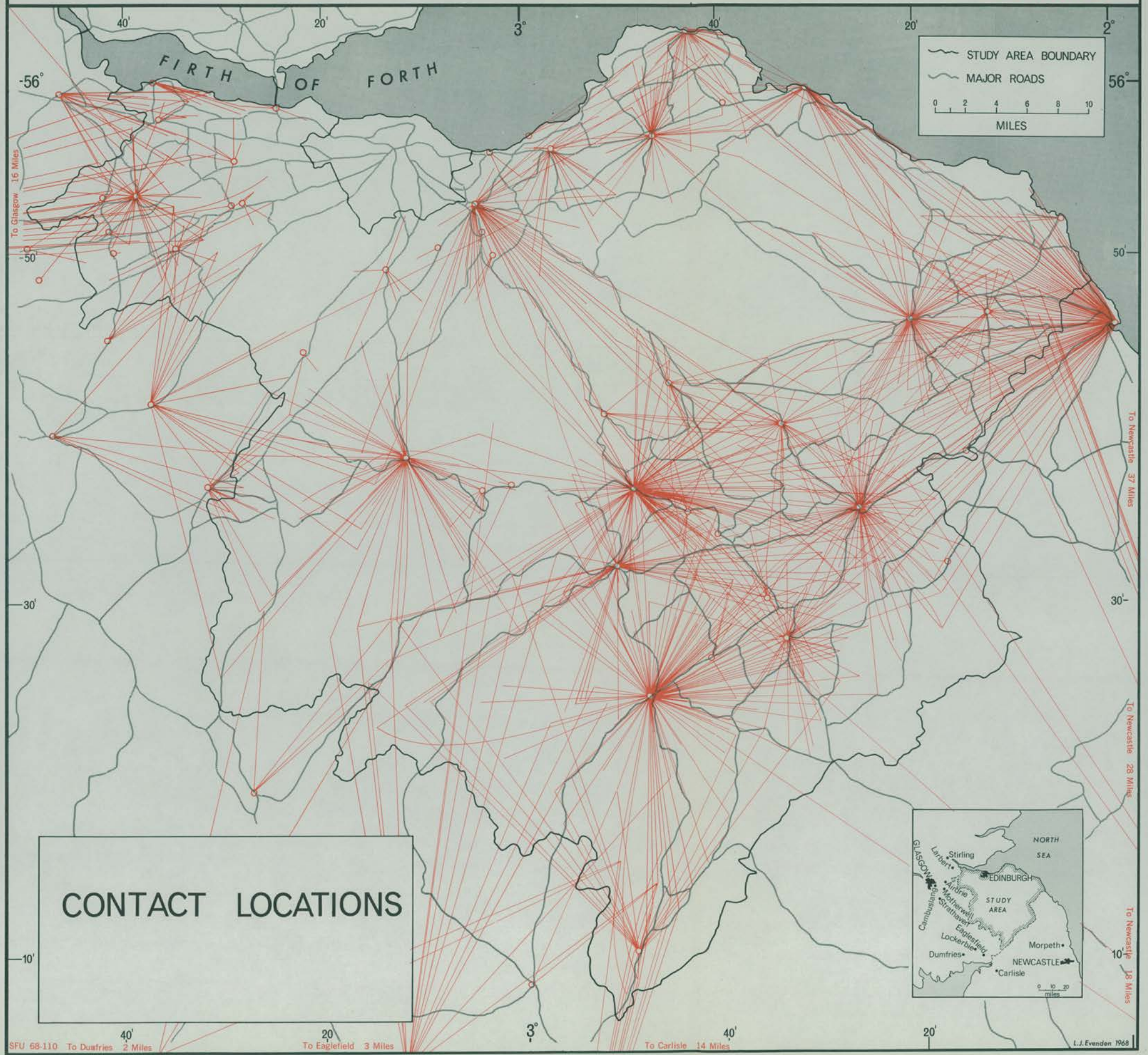
CONTACT LOCATIONS

To Glasgow 15 Miles
To Motherwell 6 Miles
To Strathaven 10 Miles
To Newcastle 37 Miles
To Newcastle 28 Miles
To Newcastle 18 Miles
SFU 68-107 To Dumfries 2 Miles
To Carlisle 14 Miles

L.J. Evenden 1968

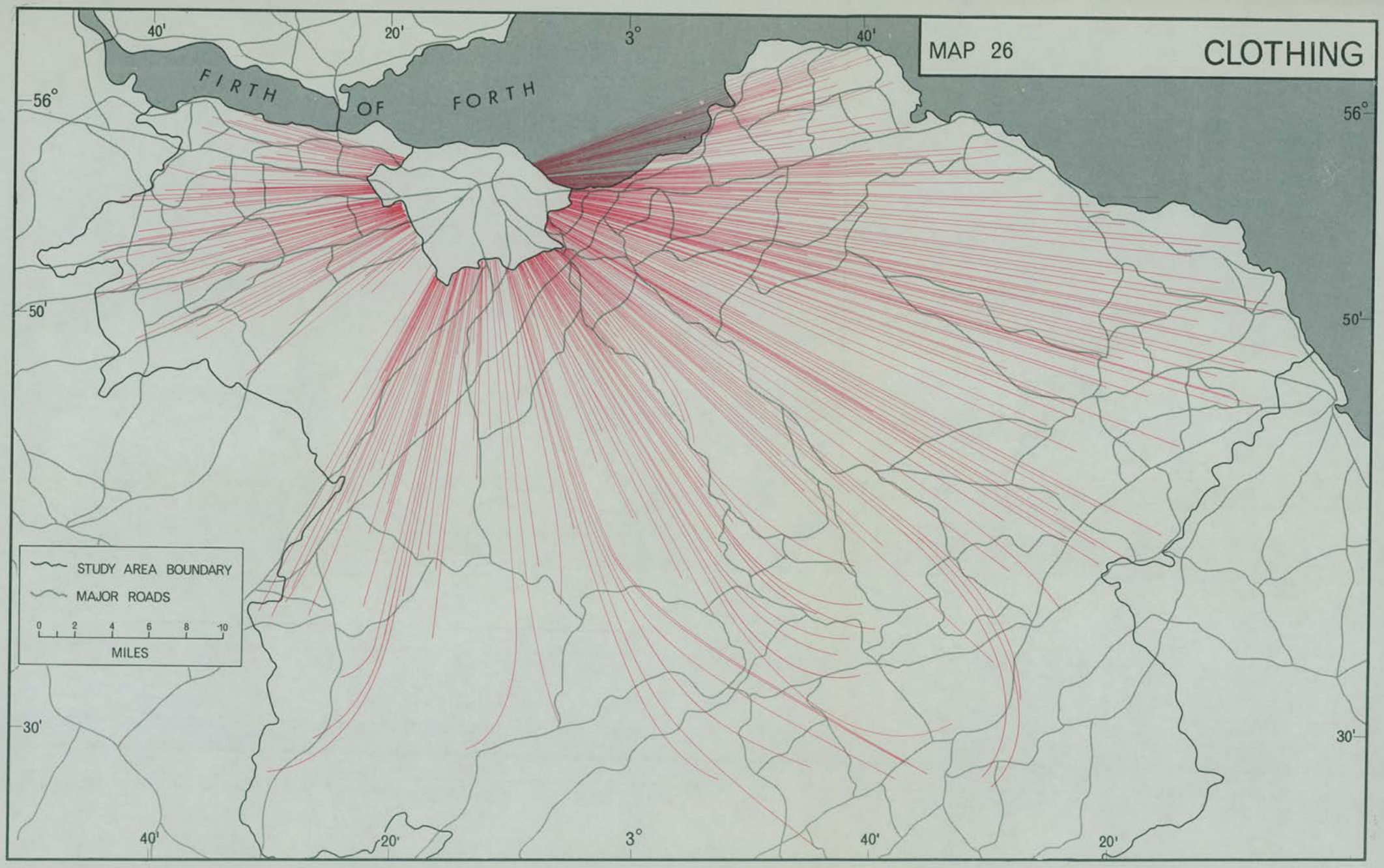
MAP 25

CLOTHING



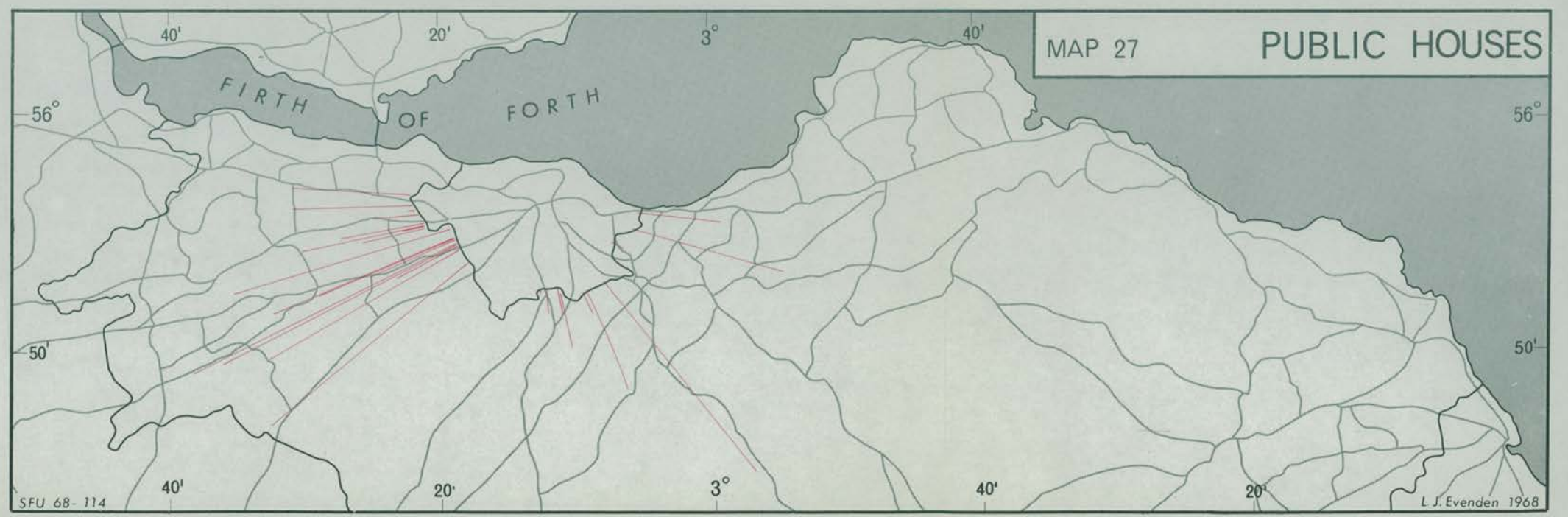
MAP 26

CLOTHING

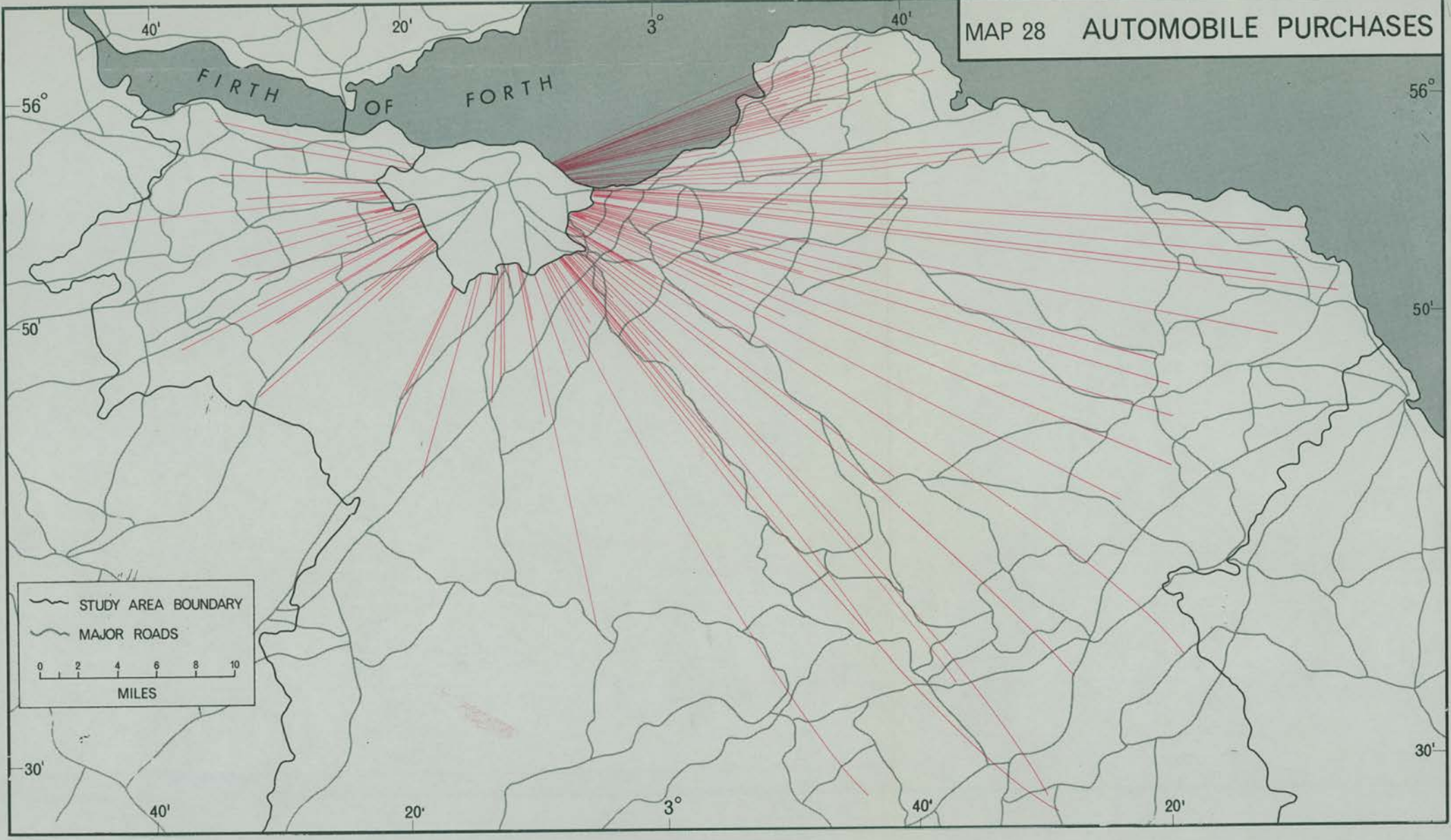


MAP 27

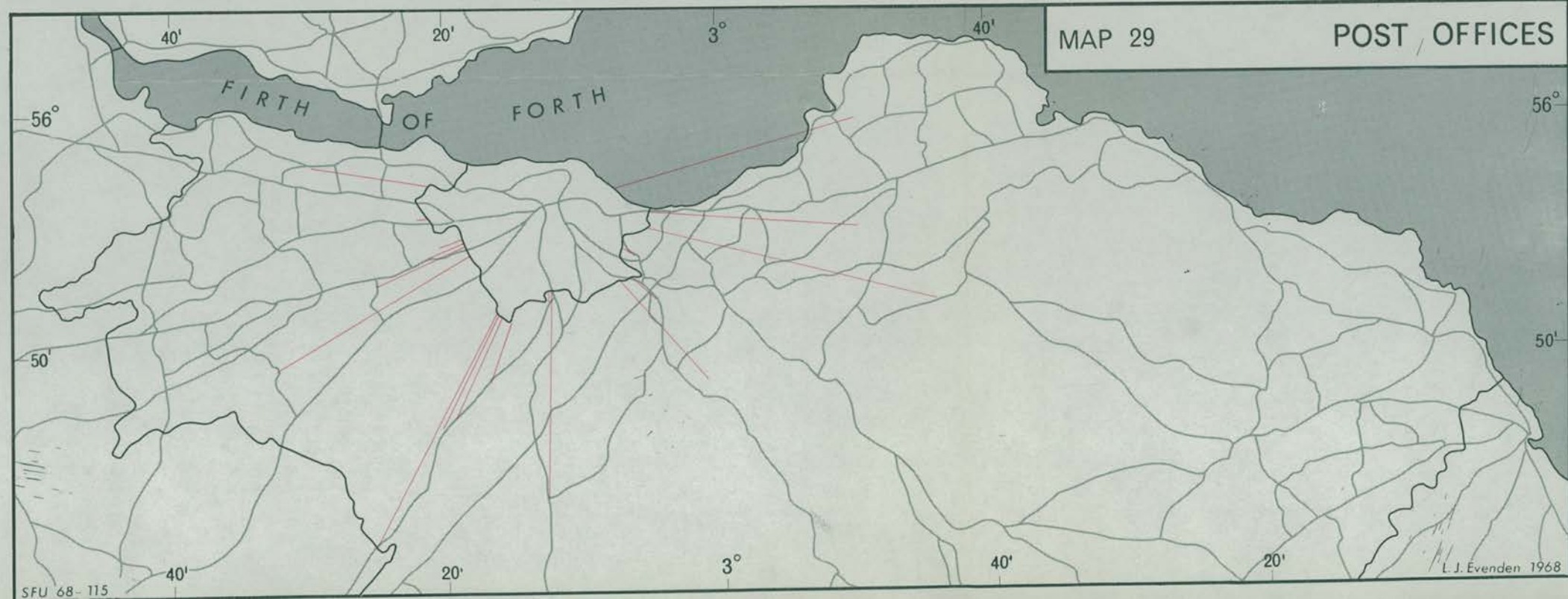
PUBLIC HOUSES



MAP 28 AUTOMOBILE PURCHASES



MAP 29 POST OFFICES

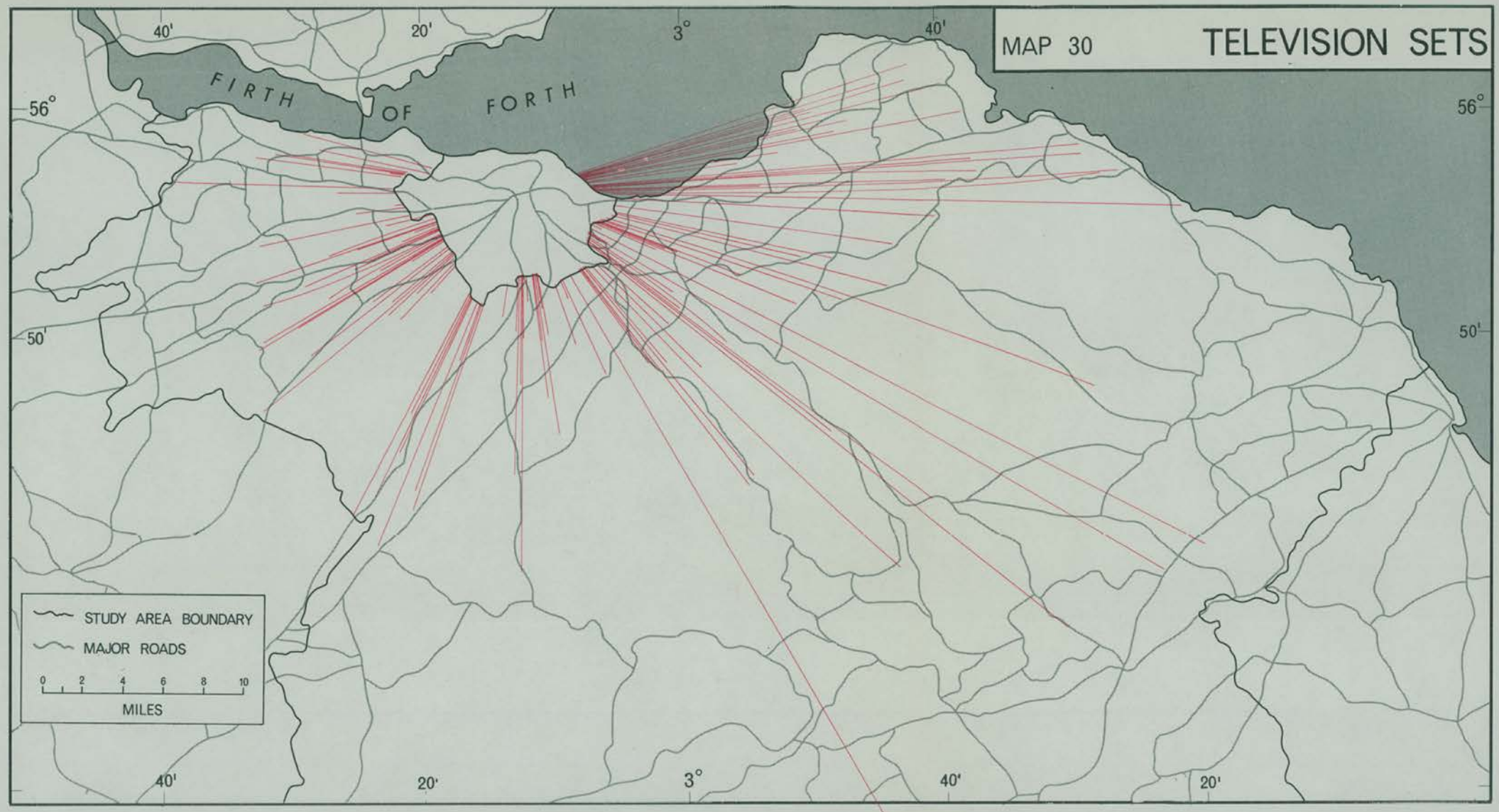


SFU 68-115

L. J. Evenden 1968

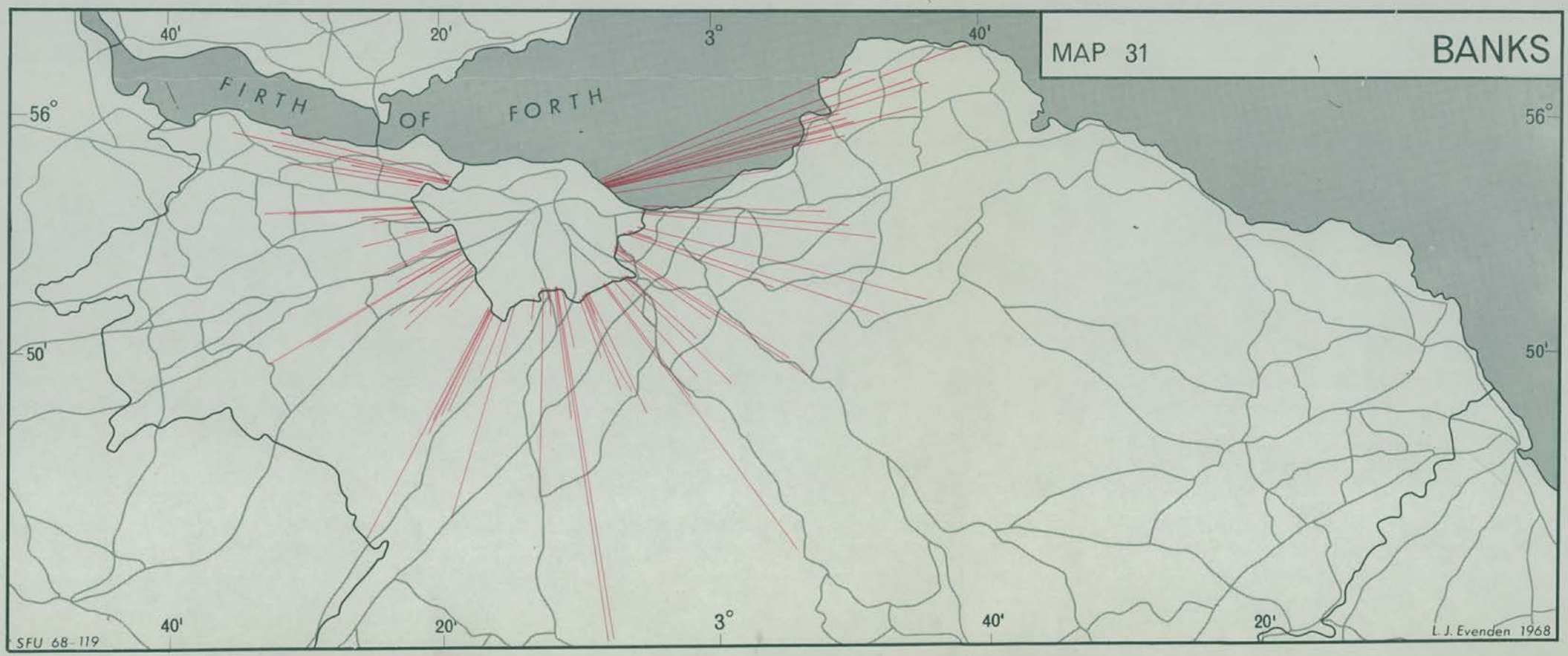
MAP 30

TELEVISION SETS



MAP 31

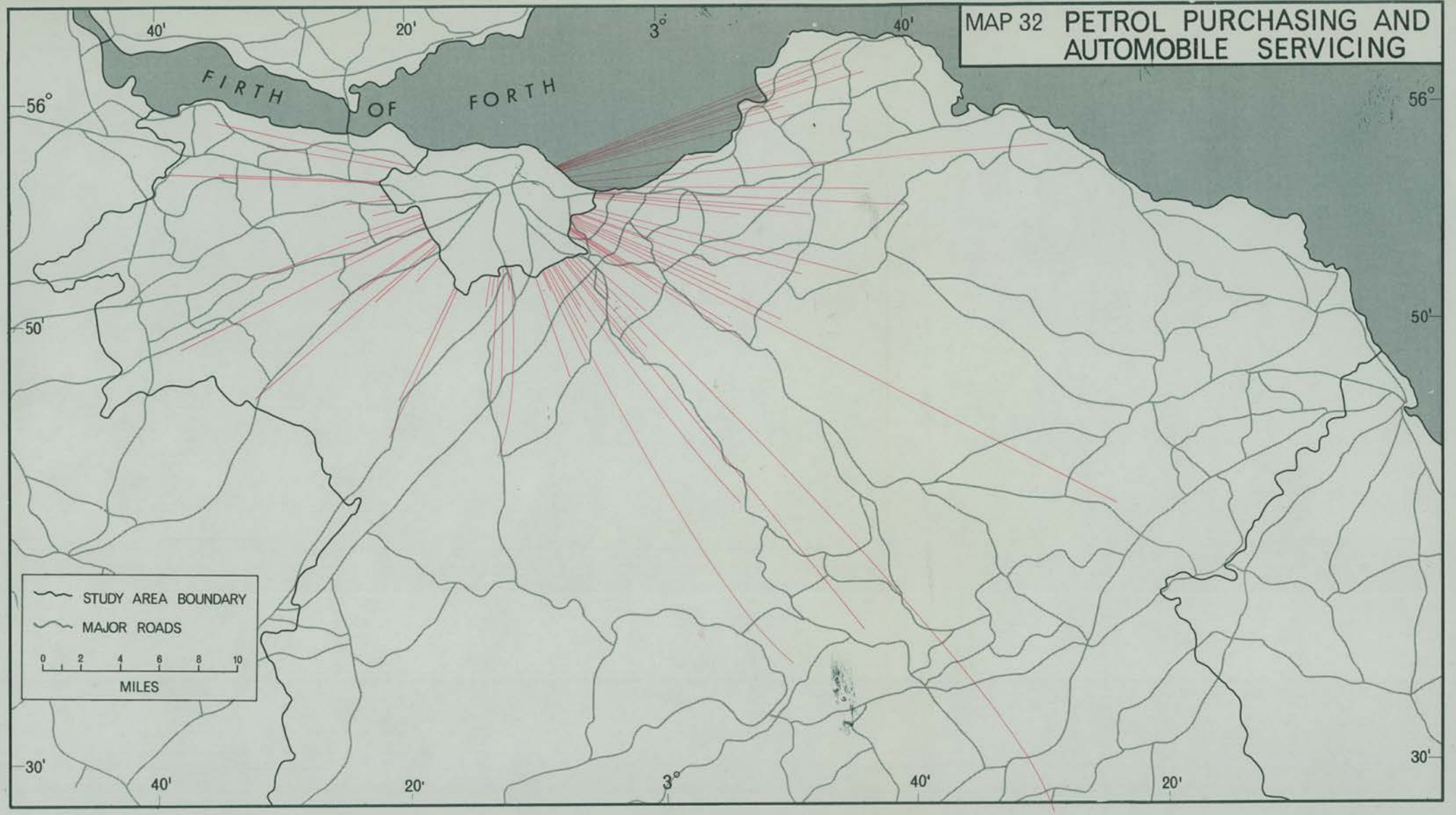
BANKS



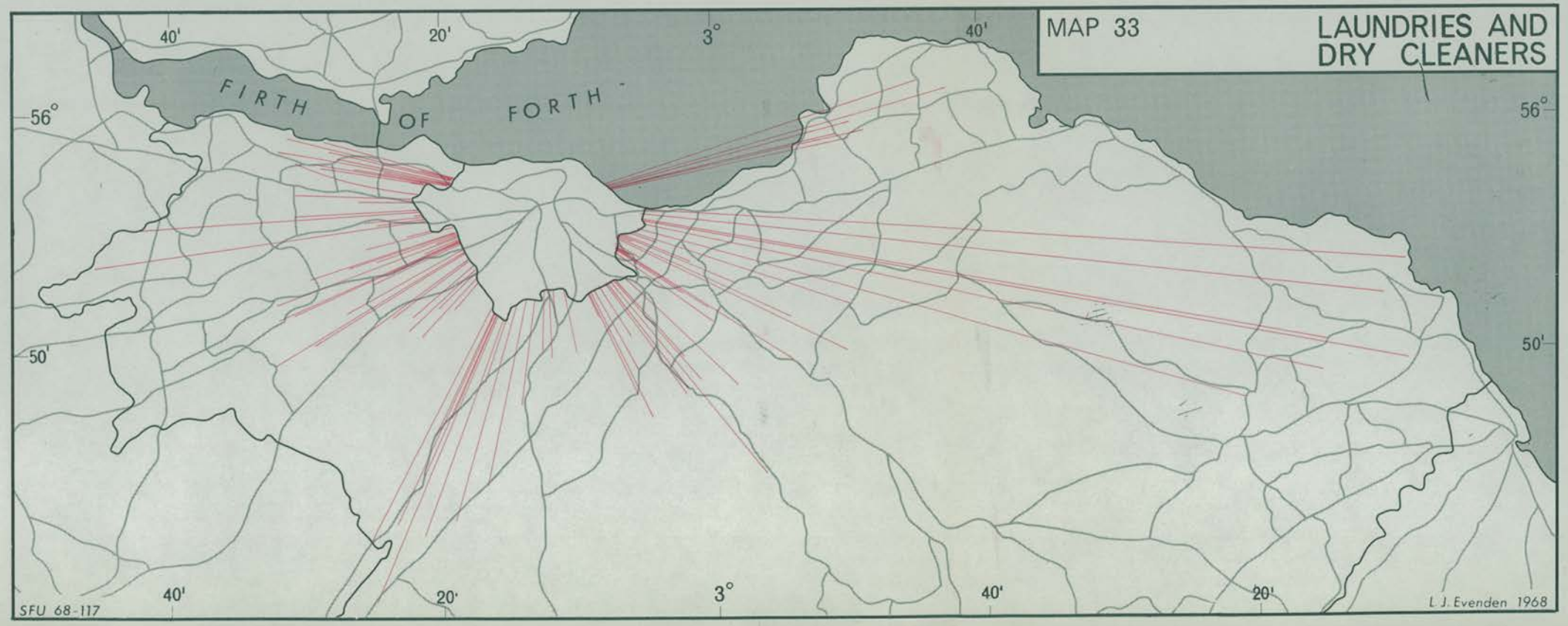
SFU 68-119

L. J. Evenden 1968

MAP 32 PETROL PURCHASING AND AUTOMOBILE SERVICING

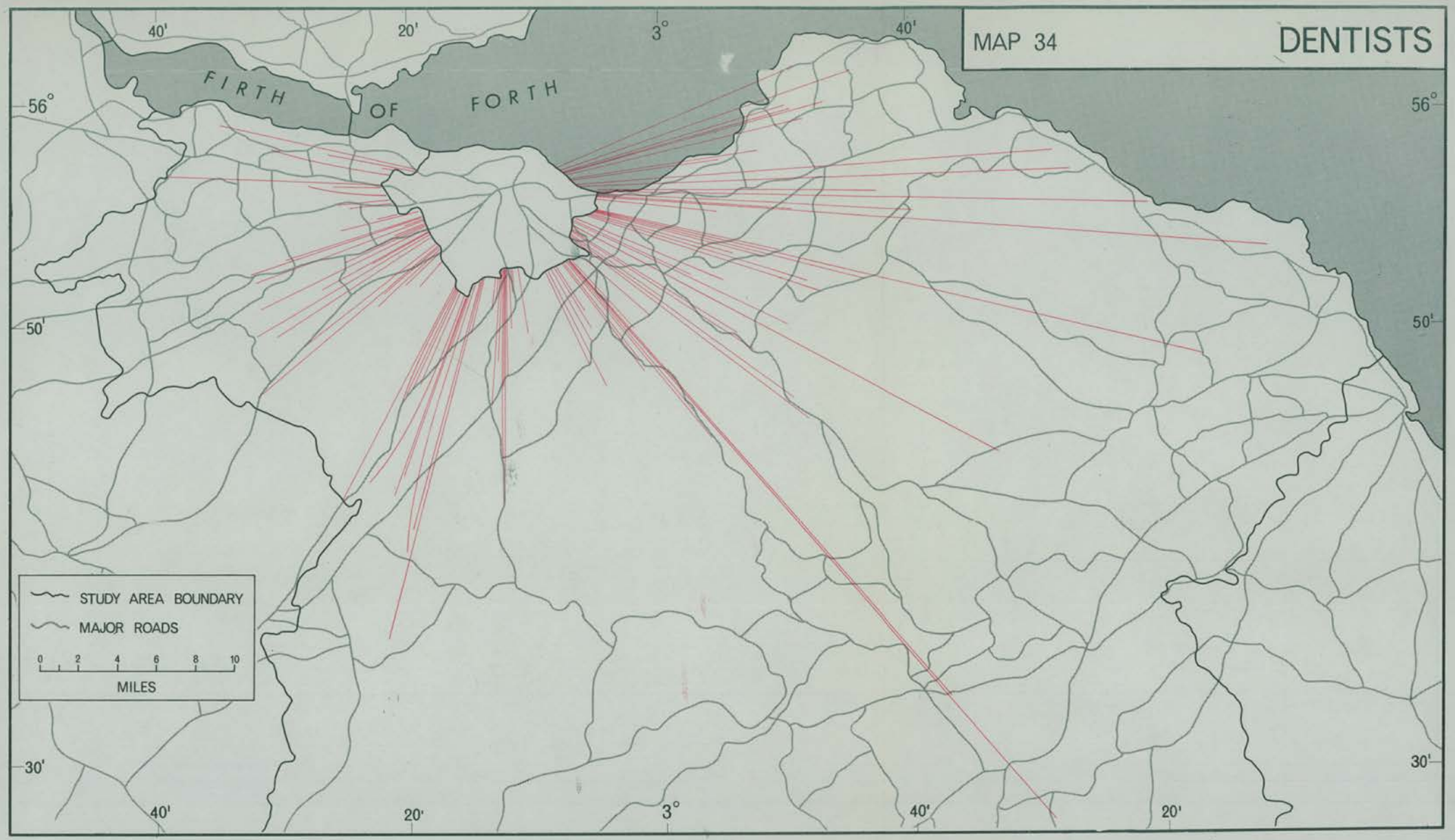


MAP 33 LAUNDRIES AND DRY CLEANERS



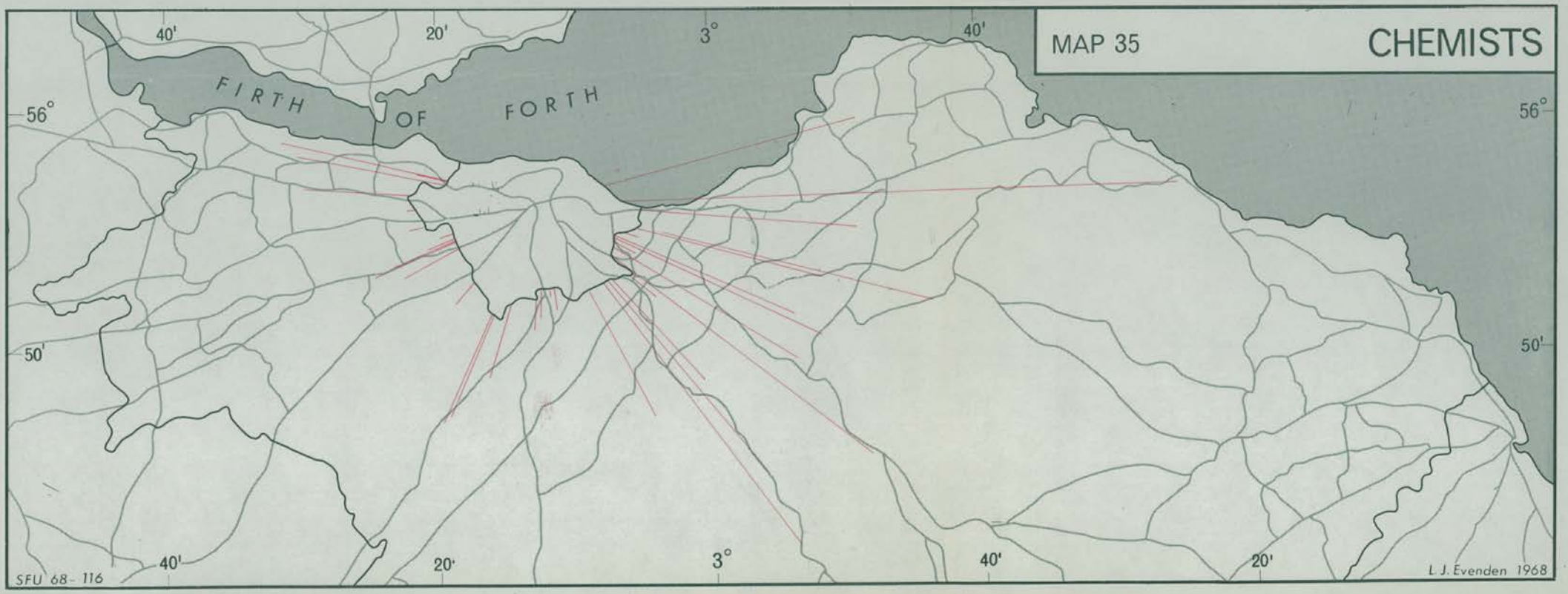
MAP 34

DENTISTS



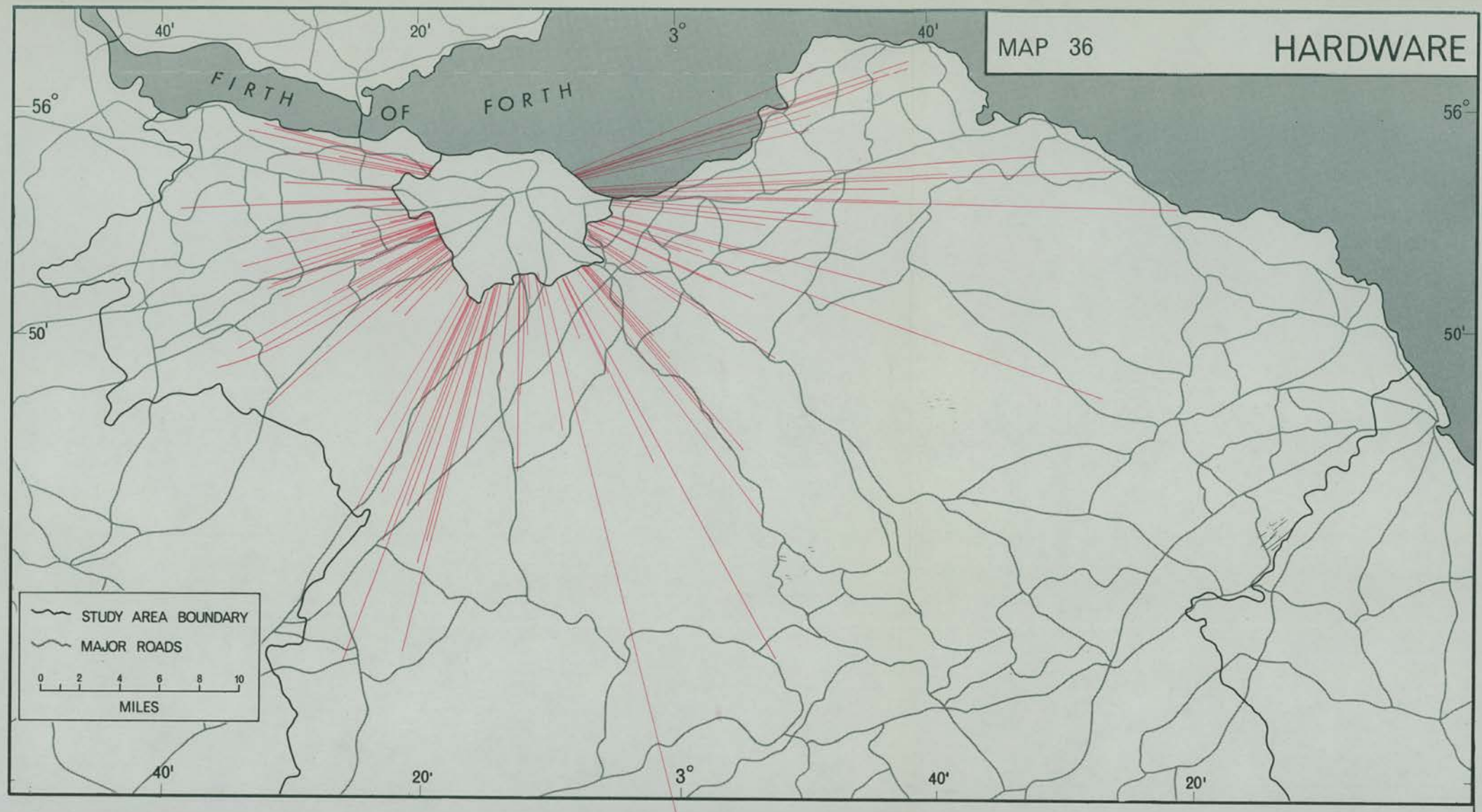
MAP 35

CHEMISTS



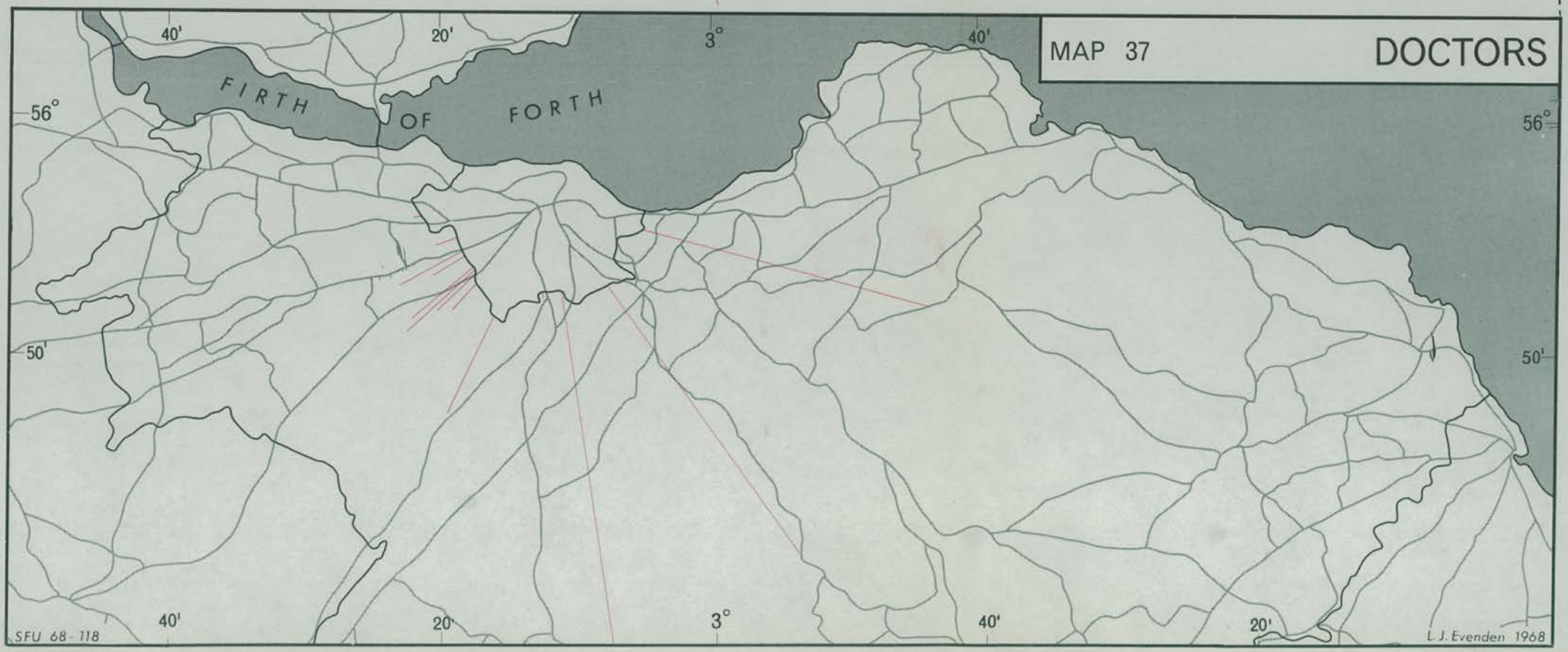
MAP 36

HARDWARE



MAP 37

DOCTORS



MAP 38

SECOND ORDER ACTIVITY CONES

FIRTH OF FORTH

STUDY AREA BOUNDARY
MAJOR ROADS
0 2 4 6 8 10
MILES

GULLANE
EAST LINTON
LONGNIDDRY
NEWBRIDGE
MID CALDER
BALERNO
ROSLIN
PATHHEAD
GIFFORD
COCKBURNSPATH
COLDINGHAM
RESTON
AYTON
CHIRNSIDE
WEST LINTON
LAUDER
STOW
GREENLAW
SWINTON
GORDON
EARLSTON
BROUGHTON
NEWTON St BOSWELLS
St BOSWELLS
YETHOLM
LILLIESLEAF
ANCRUM
MOREBATTLE
DENHOLM
NEWCASTLETON

CONTOURS REPRESENT CONTACTS PER DISTANCE RING
(level B centres)

SURFACE INTERSECTION OF EQUAL CONES

0 50
MILES
SCOTLAND
NORTH SEA
EDINBURGH
GLASGOW
IRISH SEA
ENGLAND

L. J. Evenden 1968

SFU 68-7

MAP 39

THIRD ORDER ACTIVITY CONES

FIRTH OF FORTH

STUDY AREA BOUNDARY
MAJOR ROADS
0 2 4 6 8 10
MILES

SOUTH QUEENSFERRY
COCKENZIE and PORT SETON
CURRIE
EASTHOUSE
NEWTONGRANGE
BLACKBURN
WEST CALDER
FAULDHOUSE
EYEMOUTH
DUNS
COLDSTREAM
INNERLEITHEN
MELROSE

SURFACE CONTOURS AT INTERVALS OF 10 BELOW 50 AND 25 ABOVE 50
SURFACE INTERSECTION OF EQUAL CONES
SURFACE INTERSECTION OF UNEQUAL CONES
SUB-SURFACE BASE CONTOUR
SUB-SURFACE INTERSECTION OF EQUAL CONES
CONTOURS REPRESENT CONTACTS PER DISTANCE RING

L.J Evenden 1968

SFU 68-8

MAP 40

FOURTH ORDER ACTIVITY CONES

FIRTH OF FORTH

STUDY AREA BOUNDARY
MAJOR ROADS
0 2 4 6 8 10
MILES

LINLITHGOW
BROXBURN
ARMADALE
WHITBURN
PRESTONPANS
TRANENT
NORTH BERWICK
DUNBAR
HADDINGTON
BONNYRIGG and LASSWADE
LOANHEAD
GOREBRIDGE
PENICUIK
PEEBLES
SELKIRK
JEDBURGH
KELSO

SURFACE CONTOURS AT INTERVALS OF 10 BELOW 50 AND 25 ABOVE 50
SURFACE INTERSECTION OF EQUAL CONES
SURFACE INTERSECTION OF UNEQUAL CONES
SUB-SURFACE BASE CONTOUR
SUB-SURFACE INTERSECTION OF EQUAL CONES
CONTOURS REPRESENT CONTACTS PER DISTANCE RING

L.J. Evenden 1968

SFU 68-9

MAP 41

FIFTH ORDER ACTIVITY CONES

FIRTH OF FORTH

BO'NESS

BATHGATE

MUSSELBURGH

DALKEITH

GALASHIELS

HAWICK

STUDY AREA BOUNDARY

MAJOR ROADS

0 2 4 6 8 10

MILES

SURFACE CONTOURS WITH VALUES OF 10, 50, 100, 150, 200, 250

SURFACE INTERSECTION OF EQUAL CONES

SUB-SURFACE BASE CONTOUR

LEVEL A CENTRE

LEVEL B CENTRE

CONTOURS REPRESENT CONTACTS PER DISTANCE RING

0 50 MILES

SCOTLAND

NORTH SEA

EDINBURGH

GLASGOW

IRISH SEA

ENGLAND

SFU 68-10

L.J. Evenden 1968

MAP 42

A MORPHOLOGY OF ACTIVITY